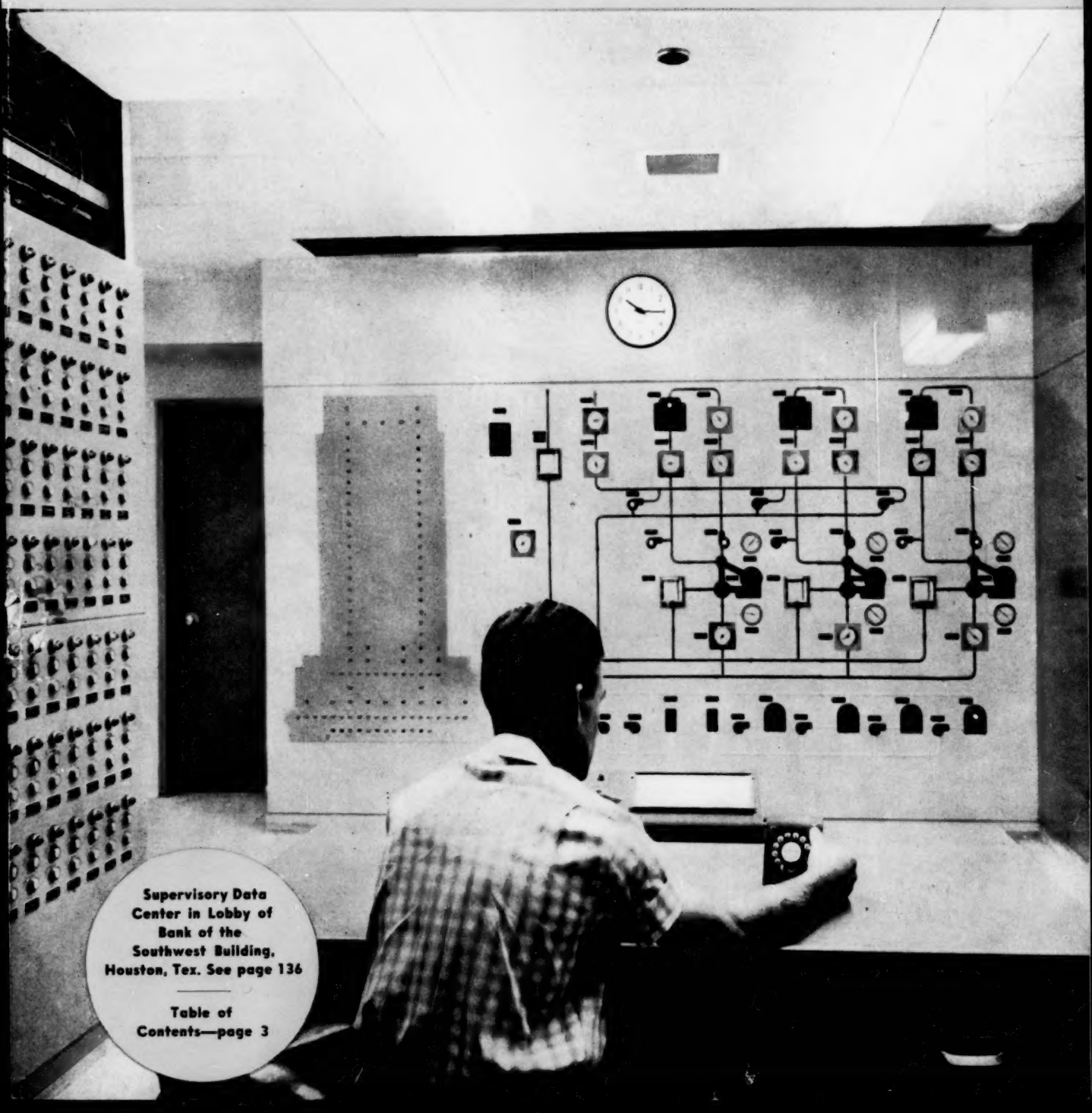
AIR CONDITIONING HEATING AND VENTILATING

SEPTEMBER, 1956—53rd YEAR



Supervisory Data Center in Lobby of Bank of the Southwest Building, Houston, Tex. See page 136

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GRINNELL GAS-FIRED UNIT HEATERS

Grinnell
Available in 7 sizes — with input ratings from 75,000 to 250,000 Btu's
All parts readily accessible for periodic servicing.

Approved by the American Gas Association and listed by Underwriters' Laboratories, Inc.

This Grinnell unit heater — burning all types of gases — is built to provide efficient, dependable service even under severe conditions. Typical of the interiors for which this gas-fired unit heater assures clean, constant heat are: factories, repair shops, garages, warehouses, stores and supermarkets.

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- **overload protection:** The low speed motors have built-in thermal overload protection and automatic reset.
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- **easy suspension:** Threaded pipe hangers are integral parts of the heater.
- **complete wiring:** Unit requires only connection to suitable room thermostat or manual switch.
- **easy maintenance:** All parts are readily accessible for periodic servicing; hinged bottom pan permits cleaning interior of tubes; burners and control assembly are removable as a unit.
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Top: Home of Alfred A. DiCenso, Williamsport, Pa., where 27 Webster Heating-Cooling Conditioners in eight separate zones comprise completely automatic year-round climate control. Architect: Wagner & Hartman. Heating Contractor: Orrin Roller. General Contractor: William Springman — all of Williamsport.

Center: Webster Heating-Cooling Conditioners, Models C-80 and C-40. Both models available in Free-Standing, Semi-Recessed or Recessed Cabinet types.

Bottom: Library-den in DiCenso residence. Note Webster Conditioners with woodgrain finish beneath windows.

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2. Chilled water air conditioning . . . with easy, flexible control of cooling temperatures, room-by-room or zone-by-zone;
3. A central system for both heating and cooling, without expensive ductwork. No window obstruction.

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AIR CONDITIONING HEATING AND VENTILATING

SEPTEMBER, 1956

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The Cover: A Minneapolis-Honeywell installation off the lobby of the Bank of the Southwest Building, Houston, Tex., makes possible central operation of air conditioning equipment in large buildings. See page 136.

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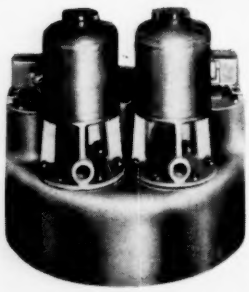

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HIGH SPOTS

• Air conditioning's role in **mitigating the effects of hay fever** in August and September has been hailed by the Air Conditioning and Refrigeration Institute after pointing to the results of laboratory tests conducted on the subject. See page 71.

• The Du Pont Company has offered to make generally available a simplified numbering system developed over the last quarter century **to identify chemical compounds used as refrigerants.**

• The Federal **Construction Contract Bill,** which would outlaw bid shopping on subcontracts, **failed to get the two-thirds majority** in the House of Representatives and was defeated by 15 votes.

• **An increase of 37%** in the shipments of air conditioning and refrigeration compressor bodies for the first four months of this year over last year has been announced by the ARI. Shipments of automotive compressor bodies also increased. See page 138.

• While only an estimated 4% of the United States supply comes from the Middle East through the Suez canal, any disruption to the petroleum flow via the canal would put **an immediate strain on this country's oil supply** because of the effects on our European allies. Higher petroleum and oil product prices would accompany any substantially larger export of American oil to Europe.

• According to the American Society for Engineering Education, there were an estimated **11,403 graduates from full-time technical institute programs** this year compared to the annual demand for engineering technicians of approximately 40,000 to 50,000. To meet this demand, enrollments would have to increase between 150,000 and 200,000. Enrollments for the year ended numbered 32,644 in full-time programs.

• Summer business activity continues at the record levels established through the first six months of the year, the Government's Office of Business Economics reported. **The advance in plant and equipment outlays** considerably more than compensated for the drop in residential construction.

• **Shipments of central heating furnaces** compiled by the National Warm Air Heating and Air Conditioning Association for the first 6 months of 1956 are, according to fuels: Coal 3.1%; Oil 30.4%; Gas 66.5% For the first 6 months of 1955 the figures are: Coal 3%; Oil 35%; Gas 62%.

• Because of **a lack of manpower,** the air conditioning industry is not making the progress it should, complained M. M. Lawler, president of the Air Conditioning and Refrigeration Institute, while recommending a program to recruit men for the industry. See page 136.

• **Baseball's first move toward air conditioning** has been made by the Cincinnati Redlegs. The team is the first major league club to air condition the players dugouts, press box, broadcasting booth, press room, and television monitor room. See page 95.

• The **63rd chapter** of the American Society of Heating and Air-Conditioning Engineers was **formed this summer** in Austin, Tex. See page 140.

WASHINGTON OVERTONES *(Continued from page 6)*

• Permits a co-signer (person or corporation) to endorse an FHA-insured mortgage for a **buyer age 60 or older.**

• **Approves FHA insurance** up to 90% on dwellings costing not more than $8,100 per family unit when built for elderly resident by non-profit organization.

• **Authorizes 35,000 public housing units** per year, this year and next.

• **Revises military housing program** to increase allowable per-unit maximum to $16,500 from $13,500. Spending under the program is limited to $2.3 billion, and the present program is to end with 1957.

• Public law 898 extends the Veterans' Administration **home loan guarantee program** to July 25, 1958.

• Two questions—**segregation and possible federal control of education**—helped prevent passage of an aid-to-education bill which would have authorized a vast amount of new school construction. New Congress, the 85th, convening next January 3, will take another look.

• Meanwhile, several piece-meal approaches to **school and hospital problems** add up to big business, constructionwise, for many months ahead.

• Public Law 949 authorizes **two year extension of federal aid** to school districts overburdened by government activities. Appropriated: $378 million for either construction or operation.

• Public Law 911 authorizes, among other things, **$210 million a year for hospital construction** for two more years from June 30, 1957.

• Public Law 835 authorizes **$90 million** over three years **for construction of research facilities** in hospitals and universities.

• These federal aid projects, added to **big outlays by industry** and commerce, promise record volume for the construction industry and its satellites despite any faltering in the housing field.

• Commerce and Labor Department Report for June placed **construction outlays at an all-time high** of $4,207 million—up $200 million from June. Seasonally adjusted, spending during July was at an annual rate of $44,388 million. Expected increase during August would raise annual rate to $44.5 billion. Total spending first seven months of 1956 hit $24.1 billion—up 2% from the same period last year. Private projects were up 1%; public projects up 5%.

• Those interested in **small business**—whether as units thereof or purveyors thereto—**may expect favorable attention** from Washington in the months ahead.

• Political platforms of both parties promise new consideration for "the little fellow." Also, the late-lamented 84th Congress passed Public Law 268—extending Small Business Act to June 30, 1957 and **increasing loan limitations** from $150,000 to $250,000.

• The President's Cabinet Committee on Small Business issued a report during August recommending several major actions to aid this segment of the business population. Principal recommendations: **tax relief for small business,** including rapid amortization of capital investment; anti-trust action to protect small business from monopolistic mergers; assistance in the purchase of strategic materials; and continued technical research directed toward assisting small business in sharing national prosperity.

• The Office of Technical Services has released a detailed guide for aircraft designers in calculating **air conditioning loads for aircraft** compartments. The 177-page manual is entitled "Engineering Study of Air-Conditioning Load Requirements for Aircraft Compartments" (PB 1211139). It may be ordered at $4.50 per copy from the OTS, Commerce Department, Washington 25, D. C.

• General Services Administration, responsible for design, construction and maintenance of more than 5,000 federal buildings, has **created three new top-level positions.** William A. Schmidt has been named new assistant commissioner for planning and Leonard Hunter, assistant commissioner for design and construction. Charles A. Peters has been appointed assistant to the commissioner. All are civil service career employees.

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BRIEFLY STATED

• The appointments of **Todd L. Owens** as manager, advertising and sales promotion, and **James M. Farrell,** sales manager, room air conditioners, were announced by the commercial division of York Corp., a subsidiary of Borg-Warner Corp.

• The appointment of **Paul A. Ryan** as advertising and sales promotion manager was announced by Janitrol Heating & Air Conditioning Div., Surface Combustion Corp. Mr. Ryan has been active in the merchandising field for seventeen years.

• **Herman F. Lehman,** new general manager of Frigidaire division, was elected a vice-president of General Motors at a meeting of the corporation's board of directors in New York City. Associated with General Motors for thirty-one years, Mr. Lehman succeeded Mason M. Roberts as general manager of the division.

• Penberthy Injector Co. is now known as **Penberthy Mfg. Co.,** according to an announcement by the parent company, Buffalo-Eclipse Corp. The change is being made to better identify the operations of this Detroit division.

• **Warren A. Logelin** has been named director of public relations for Crane Co. He succeeds Russell G. Crevistón who retired after twenty-seven years at the company's general office.

• **Don McAnally,** sales promotion manager for the L.O.F. Glass Fibers Co., has been promoted to manager of distributor sales. In his new capacity, Mr. McAnally will have charge of the distributor sales program on thermal and acoustical insulation products.

• Shareholders of **Copeland Refrigeration Corp.,** Sidney, Ohio, authorized the board of directors to proceed with the sale of a new issue of 125,000 shares of common stock. The shareholders also directed company officials to complete negotiations for a $2 million, long term loan, which with the new stock sale, will finance the company's expansion program.

• The appointment of **Dayrel G. Hoke** as sales engineer in the New York district office of J. F. Pritchard and Company of California, Kansas City, Mo., has been announced. Prior to joining Pritchard, Mr. Hoke was a sales engineer for the Kewanee Boiler Corp., in Philadelphia.

• **Robert Graves Hess** has been elected executive vice-president of Walworth Co. Mr. Hess recently resigned as executive vice-president of Pesco Products Div., Borg-Warner Corp.

• Appointment of **James C. Tobin** as central division construction manager was announced today by The Powers Regulator Co., Skokie, Ill. Mr. Tobin will advise on and coordinate installation and service work in the central division.

• The firm of **Taylor, Lipscomb & Appel, Inc.** has been appointed exclusive sales representatives of Baltimore Aircoil Co., Inc., for Virginia.

• The boiler engineering division of **Garratt Engineering and Equipment Co.,** San Francisco, Calif., has been appointed northern California distributor for Cyclotherm Div., National-U. S. Radiator Corp., Oswego, N. Y. The firm has been awarded an exclusive franchise for the complete line of Cyclotherm steam and hot water generators.

• **Harvey Lange** has joined Drayer-Hanson as sales application engineer. His key duties will be original equipment manufacturers and commercial refrigeration sales, as well as servicing liaison with factory representatives throughout the country.

• The opening of a branch office in Portland, Ore. was announced by **The Powers Regulator Co.,** Skokie, Ill. The office will handle sales and engineering of controls for contract installations (heating and cooling) and for industrial process applications.

• Decisive approval has been given by the stockholders of Bush Mfg. Co., West Hartford, Conn., and C. A. Dunham Co., Chicago, for consolidation. The new company will be known as **Dunham-Bush, Inc.** Air conditioning and refrigeration products will now be produced in Michigan City, Ind., Marshalltown, Iowa, and Toronto, Canada. Certain additional heating products will be manufactured for the first time at the West Hartford plant.

• **Howard J. Waff, Jr.** has been appointed representative for Connor Engineering Corp. Kno-Draft residential ceiling air diffusers in North and South Carolina and Georgia.

• A new sales office of the Canadian branch for the marketing of heating and air conditioning equipment produced by **National-U. S. Radiator Corp.,** Johnstown, Pa., has been opened in Toronto.

• Ansul Chemical Co., Marinette, Wis., announces the appointment of **Edward A. Beacham** as senior engineer in the new products division of refrigeration sales development. Mr. Beacham will assist in planning and executing sales development programs.

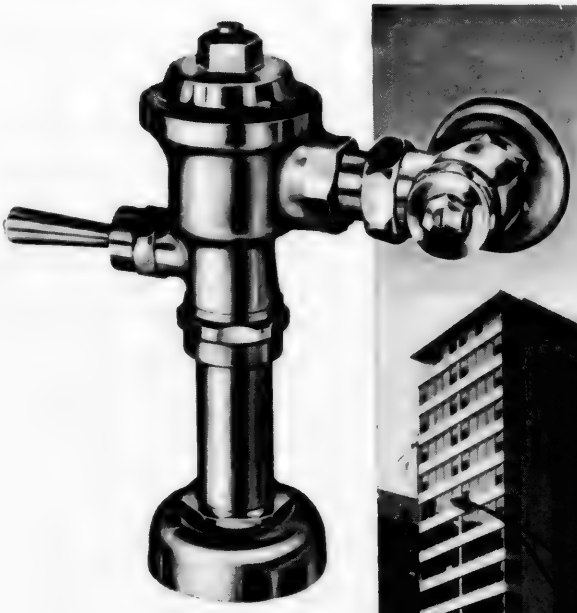
• Rochester Mfg. Co., Inc. announces the appointment of **Joe Bernard** as a sales representative to handle the company's sale of gages to the oil burner industry in eastern Pennsylvania, southern New Jersey, and Delaware.

• **C. H. Menge,** executive vice-president of Eljer Co., Pittsburgh, Pa., has been appointed general sales manager of Frigidaire Div., General Motors Corp.

• **Robert Evans** has joined the Permaglas Division, A. O. Smith Corp., as supervisor of engineering for its line of summer air conditioning equipment.

(*Continued on page* 12)

And in Chicago — A FUTURE OF FAULTLESS SERVICE



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Since 1879

BRIEFLY STATED

(*Continued from page* 10)

• **Allan R. Armstrong,** who has been associated with Chase Brass & Copper Co. in sales work since 1940, has been transferred from the company's Chicago office to its headquarters in Waterbury, Conn., where he will be staff manager of tube sales.

• Crane Co. has set up a new atomic energy unit in its engineering sales section. The unit, headed by **Fred G. Gould,** will service all inquiries and orders for valves, fittings, and other equipment in the field of atomic energy.

• **J. M. Osborne** has been named Southern regional supervisor of unit ventilator and heating and ventilating products for American Air Filter Co., Inc. He will be located in St. Petersburg, Fla.

• Announcement has been made by the National Association of Power Engineers of the election of **J. Dudley Holmes** as national vice-president. The election was made at the annual meeting of the association at the Hilton Hotel in Fort Worth, Tex.

• **Morris G. Munson,** St. Petersburg, Fla., has been appointed Southern regional manager of American Air Filter Co., Inc. Mr. Munson will be responsible for the field sales organization of the company in the states of Florida, Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas, and Oklahoma.

• **Colorado Research Corporation,** with headquarters in Denver, has been formed as a subsidiary of Carrier Corporation. Initially, the new organization will confine itself to the fields of electronics and applied physics, but special work related to air conditioning will be done for Carrier Corporation.

• **S. Charles Tarnoff,** former sales engineer for Sturtevant Division, Westinghouse Electric Corp., has been appointed manager of the new Chicago office and warehouse of Tuttle & Bailey Div., Allied Thermal Corp., New Britain, Conn.

• **R. R. Allen** has been named vice-president and director of engineering and research for the John Wood Co., New York, N. Y. Mr. Allen will be responsible for the engineering research and development activities of seven domestic plants and three Canadian plants.

• **Chet Aams Co.,** Richmond, Va., is now representing the Pacific Steel Boiler Division, Johnstown, Pa., through the Richmond office as well as through a branch office in Norfolk. The two locations are classed as sub-offices of the Division's district sales office in Washington, D. C.

• Jas. P. Marsh Corp. has announced the appointment of **Harry Kirby** to the post of district manager with headquarters in Cleveland, Ohio. Mr. Kirby will direct the sale of Marsh instruments and valves in Ohio, Pennsylvania, and the greater portion of New York State.

• **Robert V. McCallister** has been elected vice-president of Thermo-Flex Corp., Toledo, Ohio. In his new capacity, Mr. McCallister will be responsible for the distribution of L.O.F. Glass Fibers thermal, acoustical and home insulation, Minnesota Mining adhesives and tapes, air filters and fabricated products to the equipment and appliance industry in Toledo and northwestern Ohio.

• **Gerald Van Steenbergh,** manager of government relations for The Trane Company, has been appointed to the Department of Commerce Industry Advisory Committee for air conditioning, commercial and industrial refrigeration. Functions of the committee are to work closely with the Business and Defense Services administration, which assists business concerns throughout the country. This is the agency that would play a vital role industrially in time of emergency.

• **Zurn Industries, Inc.** is the name for a newly-formed industrial group that resulted from an overall corporate revamping program recently completed at Erie, Pa., for the J. A. Zurn Mfg. Co. As a result all affiliates and subsidiaries have now been merged into one common corporate entity.

• **Tube Turns,** Louisville, Ky., has bought thirteen acres of industrial property for expansion purposes. The price was $2 million. Earlier, 2.6 contiguous acres were acquired.

• **James H. Faller,** former general field representative for Tuttle & Bailey Div., Allied Thermal Corp., New Britain, Conn., has been named manager of the company's new Philadelphia, Pa., office and warehouse. The office will offer engineering service to help customers solve specific air distribution problems.

• **J. L. Krouse** has been assigned to the special products department of Goodyear Tire & Rubber Company's industrial products division to handle sales of the company's electrostatic air filters. Mr. Krouse replaces E. F. Poling, who has left the rubber firm.

• **Frederick B. Seel** has been promoted to assistant manager of engineering at the Holyoke division of Worthington Corp. In his new post, Mr. Seel will assume engineering administrative responsibility for air conditioning and refrigeration products which are manufactured at the division.

• Kritzer Radiant Coils, Inc. announces the appointment of **Tennessee Heating Sales Co.,** of Knoxville, Chattanooga, Nashville and Bristol, as its sales representative in the eastern Tennessee area for unit heaters, convectors, dual vectors and water chillers. The sales of baseboard radiation and fin tube products will continue to be handled by **James A. Harwell** of Nashville.

• The opening of a new warehouse to serve the Philadelphia, Pa., area has been announced by **Mueller Brass Co.,** Port Huron, Mich. The company has operated a sales office in Philadelphia since 1938. This will now be housed in the warehouse building.

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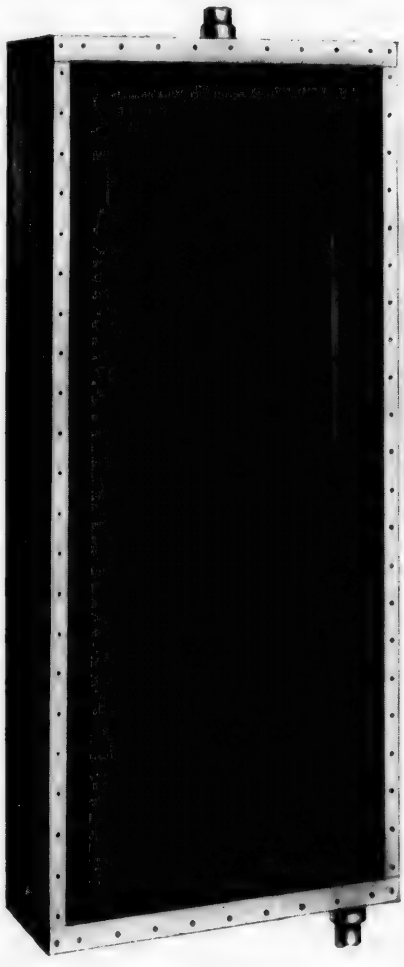

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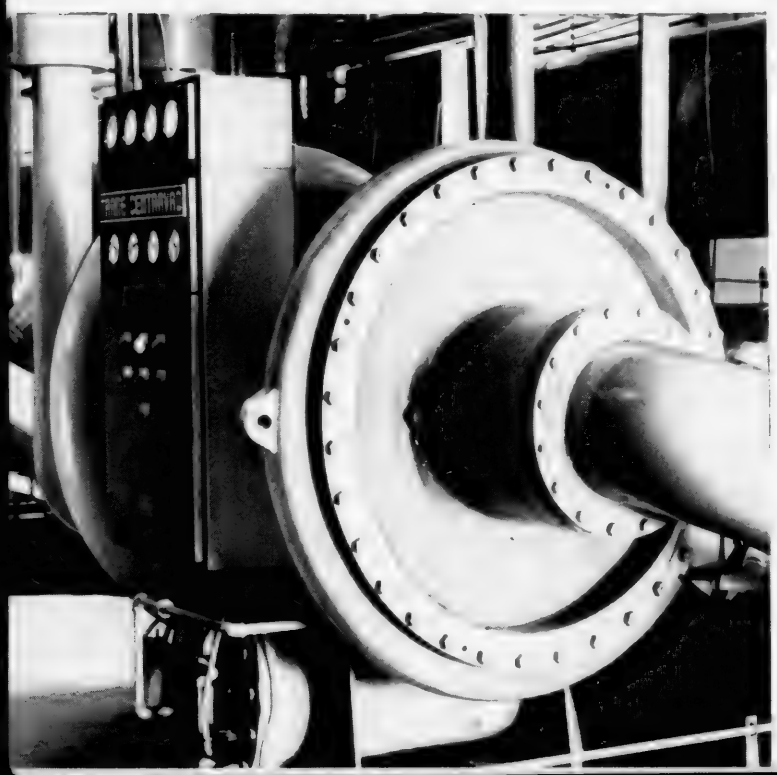
AEROFIN CORPORATION
101 Greenway Ave., Syracuse 1, New York

This ultra-modern, almost windowless, single-story W-K-M plant occupies 12 acres in a 75-acre site at Missouri City, Texas —20 miles from downtown Houston. The 2,250-ton TRANE air conditioning system uses chilled water in summer, hot water in winter—circulated through the same piping system—to provide ideal working conditions the year around. System was designed and engineered by the Dell Corporation of Morton Grove, Ill., using TRANE equipment throughout. Installation was made by the Dell Corporation and Charles G. Heyne & Company of Houston, Texas. J. Emil Anderson & Son, Inc. of Houston and Chicago, were the designers, engineers and builders of the plant.

New 500,000 square *comfort* air



Three Trane CenTraVacs like this provide the chilled water for W-K-M's factory air conditioning system. These hermetically sealed compressors have a combined cooling capacity of 2,250 tons . . . chill 324,000 gallons of water per day. TRANE CenTraVacs were chosen for this important cooling job because of their ability to meet the wide variations in cooling demand. One, two or three units may be operated as the load fluctuates. Regulated entirely by automatic controls, they require no attendant.

For heating, cooling, ventilating...
For any air condition, turn to

TRANE

MANUFACTURING ENGINEERS

foot factory gets conditioning by Trane

Year-around peak efficiency conditions for 1,100 employees in W-K-M's ultra-modern Houston plant!*

Perfect working conditions the year around are assured for the 1,100 workers in W-K-M's new plant near Houston, Texas. The 500,000 square foot factory building is completely air conditioned by TRANE equipment that cools in summer, heats in winter . . . provides built-in "ideal weather" all year long!

The factory air conditioning system, with an air handling capacity of 585,000 cfm, consists of fourteen electronically controlled zones. High pressure design, with smaller ducts, saves manufacturing space . . . permits lighting equipment that is only 15 feet above floor level.

Three TRANE CenTraVacs—hermetically sealed centrifugal compressors—supply chilled water for the factory system. A fourth CenTraVac handles the requirements of the administrative offices. Engineering offices are cooled by a #50 CT TRANE Condensing unit, with a TRANE Multi-Zone Climate Changer. Roof-mounted, the equipment transmits no noise into the building to disturb occupants.

Each year, more and more manufacturing plants are turning to TRANE for year around air conditioning because they have found that—in their plants or industries—modern air conditioning could more than pay its way by increasing production, boosting efficiency and reducing wasteful employee turnover.

For information on comfort or process air conditioning—for a new or existing plant—just call your nearby TRANE Sales Office. Or write TRANE, La Crosse, Wis.

**W-K-M Manufacturing Company, Inc. is a subsidiary of ACF Industries, Inc., specializing in the manufacture of valves and fittings for use in petroleum, gas, chemical and other process plants.*

THE TRANE COMPANY, LA CROSSE, WIS. • EASTERN MFG. DIV., SCRANTON, PA. • TRANE COMPANY OF CANADA, LTD., TORONTO • 90 U.S. AND 19 CANADIAN OFFICES

The MASSACHUSETTS Line

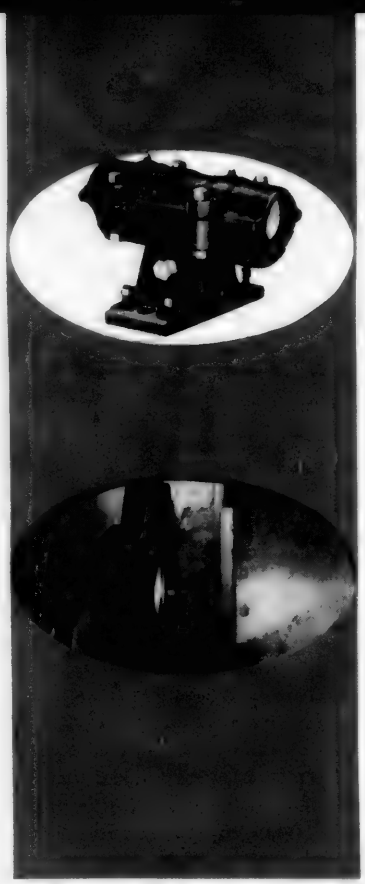
A PERFORMANCE HARD TO MATCH!

MASSACHUSETTS FANS HAVE SERVED KENYON STREET SCHOOL, PROVIDENCE, R. I., CONTINUOUSLY FOR 58 YEARS ! !

Massachusetts Fans installed in 1898 now being replaced due to remodeling. Nineteenth century styling conforming with dated engineering standards.

A NEW UNIT TO EXTEND THE CONTINUOUS SERVICE . . .

Modern design incorporating improved engineering developments and fabricating methods. Consulting engineers, Hayden, Hadding & Buchanan of Boston.



The BISHOP & BABCOCK Mfg. Co.

Our challenge stands

—anything that can be made of steel sheets can be made of

WHEELING

SOFTITE®

Galvanized Sheets

Believe it or not, this galvanized recessed ceiling light reflector housing was made by spinning. *"Impossible,"* you say? *"Can't be done with ordinary galvanized steel"?*

You are right! It *isn't* made of ordinary galvanized steel.

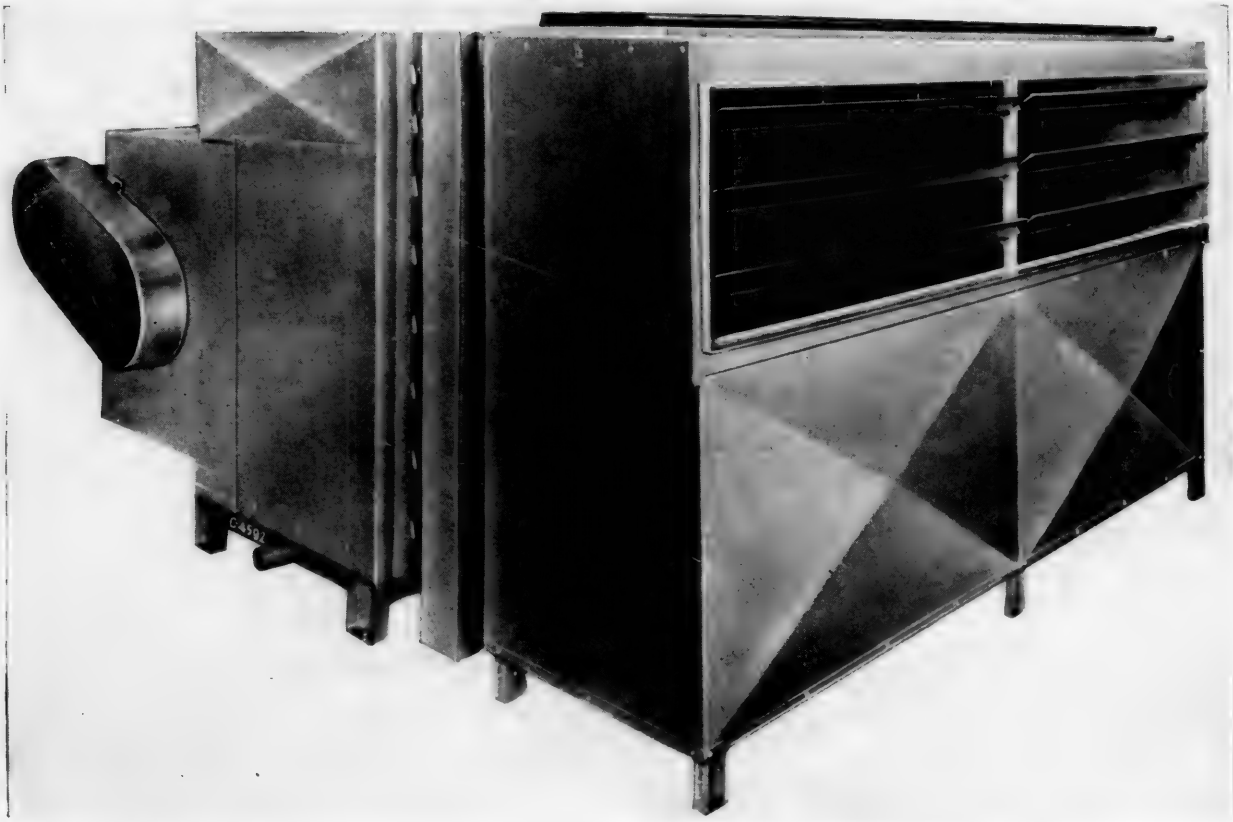
It's made of Wheeling SOFTITE, the tightest-coated galvanized sheet yet produced. So tight it won't chip, crack, flake or peel no matter how severely it is formed. It even takes *spinning* in its stride. In fact, *anything* that can be made of steel sheets can be made of Wheeling SOFTITE.

That's SOFTITE . . . made by the same company that developed Cop-R-Loy, the original copper-bearing steel pipe . . . and DUCTILLITE, the original cold reduced tin plate. Now SOFTITE, the ultimate in ductile, tight-coated galvanized steel sheets . . . a product of Wheeling Steel Corporation, Wheeling, West Virginia.

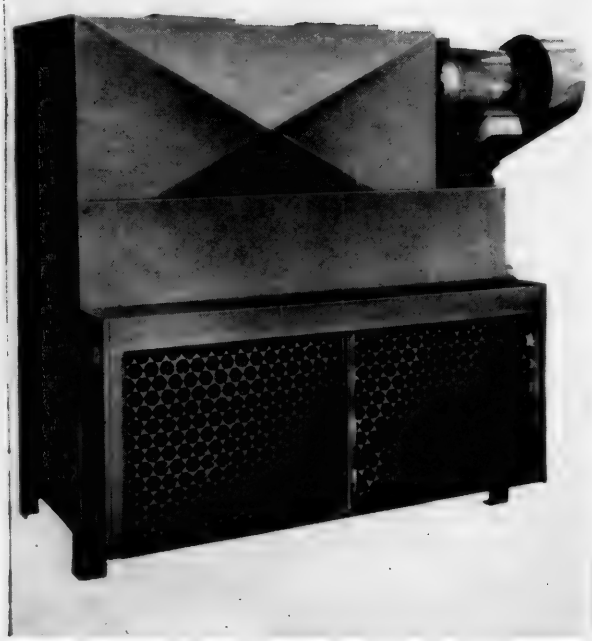
IT'S WHEELING STEEL

District Offices — Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Houston, New York, Philadelphia, St. Louis, San Francisco

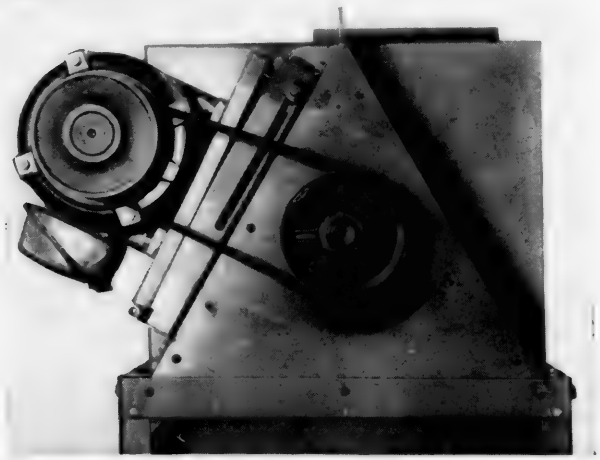
Announcing Worthington's



HORIZONTAL CONSTRUCTION of new Worthington air handling units allow them to be suspended from platform or ceiling (with hanger lugs.) Here is a large sized unit with damper section. Standard unit consists of fan section, fans, V-belt, drive (with variable pitch pulley), bypass and damper section, direct expansion or chilled water coils, and base section.



SMALLER SIZED UNITS are shipped completely assembled for horizontal or vertical arrangement shown above.



ADJUSTABLE MOTOR BASE, exclusive with Worthington, offers a 3½" variation in center distance. Adjusted with a single screw, a locking bolt secures base in proper position. This feature assures positive adjustment, enables you to keep belt tension correct. Belt turns on an adjustable pitch pulley which permits variation of fan speed and air quantity.

complete new line of flexible air conditioning units

Compact units—from 1½ to 106 tons—are easy to install—have many exclusive features

Here's a new line of unusually compact air conditioning units for commercial and industrial use in conjunction with central system air conditioning.

Designed by Worthington for easy installation, the standard unit consists of a base section, fan section and coil section. A bypass and damper section can be bolted directly to the coil face at the factory if desired, adding no height to the unit.

Units are extremely flexible. The fan section may be mounted with front, top or rear discharge. You can adjust speed for desired capacity and static pressures. Adjustable motor base offers 3½" variation in center distance for positive adjustment of belt tension. The motor mounts on the front, top, back or either end. Accessories are interchangeable between horizontal and vertical units.

Engineered by Worthington for long, trouble-free life, all sections are constructed of rugged fabricated steel, Bonderized and coated with a corrosion resistant enamel. Dynamically balanced, forward curved fans give maximum efficiency, quiet operation. (Fan shaft rides on lubricated-for-life bearings.)

For more facts on this new line of air conditioning equipment, write Worthington Corporation, Air Conditioning and Refrigeration Division, Section FO, Harrison, N. J.

These features add up to flexibility

- **Exclusive** adjustable motor base assures simple, positive adjustment of belt tension.
- **Motor mounts** on front, back or either end of unit.
- **Fan discharge** can be front, top or rear, as you prefer.
- **Accessories interchangeable** between the horizontal and vertical units.

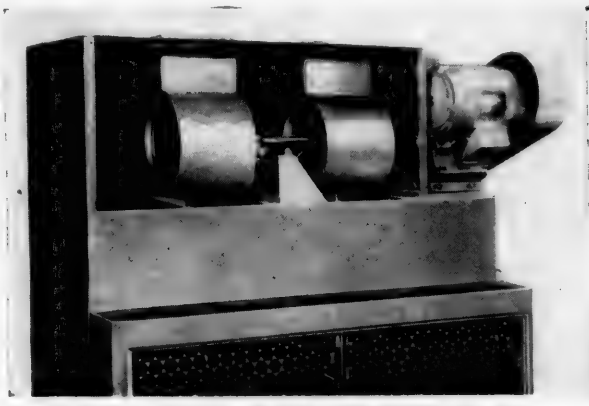
And look at these extras!

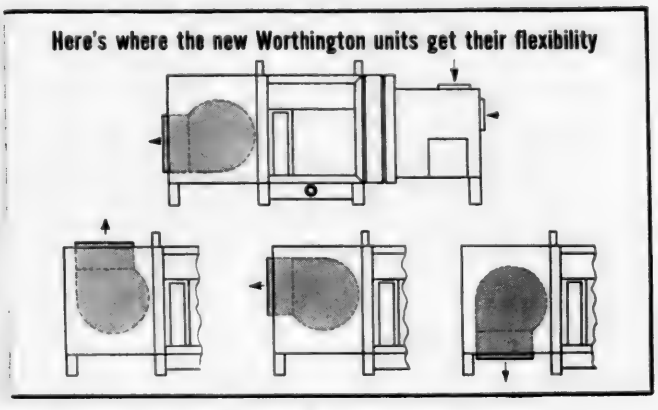
- **Up to 19,000 CFM!** You get more capacity from compact units.
- **Easy installation.** Choose either horizontal or vertical units.
- **Up to 81 different coil** combinations.
- **Lubricated-for-life** fan shaft ball bearings.
- **Accessibility!** Entire fan section can be easily removed. Removable panels and casings simplify inspection, oiling and adjustment.

A.8.75-V

WORTHINGTON

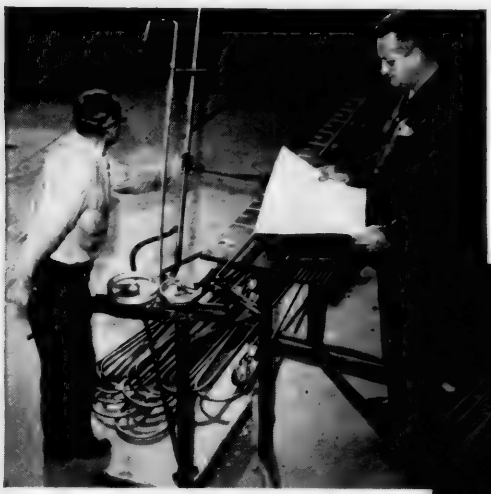
CLIMATE ENGINEERS TO INDUSTRY, BUSINESS AND THE HOME





ADJUSTABLE DISCHARGE. Fan section may be mounted with top discharge as shown above. Or discharge may be directed to front or rear of the unit. See diagrams.

SUPERIMPOSED on the photograph of the living room, in one of the homes of the Crabapple Court tract, is a section of the radiant panel heating system. With radiant panel heating picture windows can be brought right to the floor line, allowing a free rein in interior decor and furniture arrangement. And with radiant heat there are no drafts, no hot and cold zones.

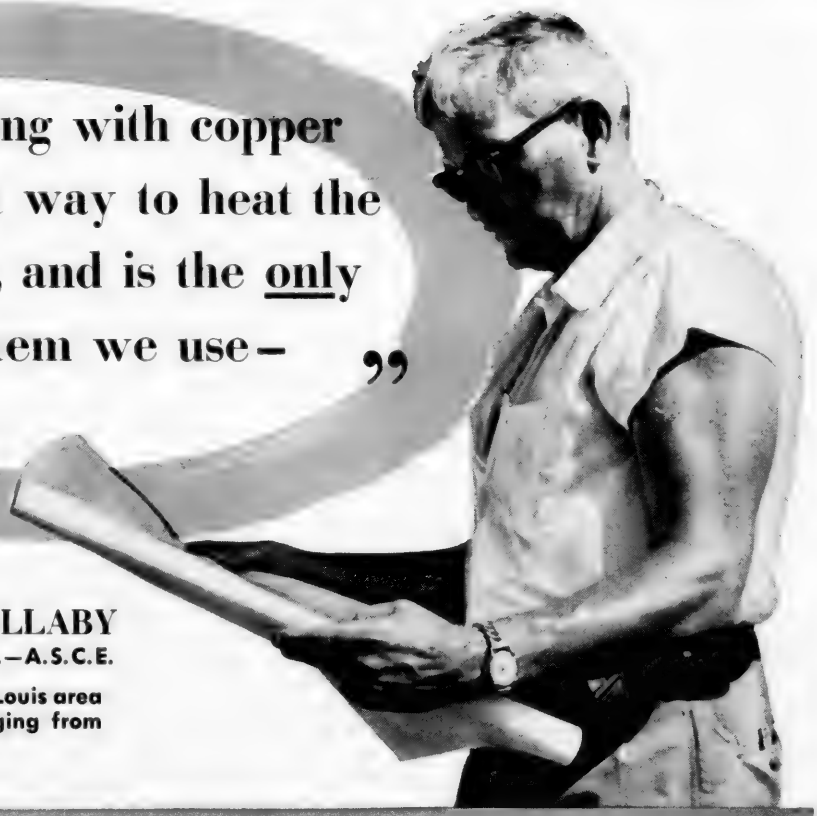


CONTRACTOR FOR THE CRABAPPLE COURT tract is the THERMAL ENGINEERING COMPANY of St. Louis. Here you see MR. L. L. VOLLMAN, Vice President of THERMAL, checking the bending of Revere Copper Water Tube in the shop. Tube was procured through the GRINNELL COMPANY of St. Louis.

ONE OF THE MANY DESIRABLE FEATURES of enduring Revere Copper Water Tube is that it can be prefabricated in the shop, requires fewer fittings, which when properly brazed or soldered assure tight, nonleaking joints. Completed, prefabricated panels are then shipped to the job and installed, using separate circuits for each room.

BY BRINGING EACH HEATING PANEL individually to a common header, as shown in the boiler hookup, and equipping each with its own valve, heat is easily and accurately regulated to suit individual room requirements.

"Radiant heating with copper tube is the best way to heat the modern home, and is the only heating system we use—"



Says CHARLES H. ELLABY
F.R.S.A.—A.S.C.E.

Builder of 152 homes in the St. Louis area during the past 6 years, ranging from $9,500 to $30,000.

A FEW OF THE 37 HOMES on the Bon-Price tract built by CHARLES H. ELLABY. Price range from $20,000 to $30,000. Homes have summer air conditioning with a central system, using ducts in the ceiling.

"There are five main reasons why we use copper tube in our radiant heating systems," continued Mr. Ellaby. "First—copper tube doesn't rust, rot or deteriorate, so we have no worry on that score. Second—a radiant system with copper tube is competitive in cost with other top quality heating systems for multiple home building. Third—copper tube is easier to work with . . . requires fewer fittings . . . can be prefabricated in the shop. Fourth—copper tube enables us to guarantee the home owner a trouble-free job. Fifth—copper tube, because of its proved, superb performance in radiant heating and hot and cold water lines, has unquestionable acceptance among prospective home owners . . . in many cases helps sell our homes."

Take a tip from this successful builder of quality homes; don't take chances, use Revere Copper Water Tube not only for radiant panel heating, but for hot and cold water lines, air conditioning lines, waste lines, vent stacks, and underground service lines.

So, when you write your next set of "specs" remember: there is no "or equal" for copper water tube. Keep out of trouble by using Revere Copper Water Tube.

And if you would like aid in the various methods of installing Revere Copper Water Tube, our Technical Advisory Service will be glad to help.

FREE!—For group showing—instructive 16 mm motion pictures in sound and full color. "THE ABC OF RADIANT PANEL HEATING" and "THE RURAL WATER SYSTEM." Write Advertising Dept., for details.

COPPER ★ BRASS ★ 18 01 ★ REVERE ★ ALUMINUM

REVERE COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Brooklyn, N.Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y.
Sales Offices in Principal Cities, Distributors Everywhere.

these "Extras" in CHICAGO PUMPS mean Longer, Better Performance Lower Cost Operation and Installation

FLUSH-KLEEN Sewage Ejector TYPE "S"

The Flush-Kleen Sewage Ejector can't clog because only liquid is handled by the impeller. Coarse matter is strained out, then backwashed from the strainer into discharge pipes. No strainer baskets to clean, no repairs due to clogging, no foul basins because solids never reach the wet basin. Besides being easier to maintain, Flush-Kleens last longer and require less power. Write for details in Bulletin 122C.

DOUBLE SUCTION HORIZONTALLY SPLIT CASE PUMP

Accurately machined and fitted revolving parts in carefully cast casing. Have proved reliable for house pump, circulating and booster service. See Bulletin 101.

TYPE AVC CONDENSATION PUMP AND RECEIVER

Low inlet — no elaborate foundation needed for installation—for systems to 10,000 EDR and 10-30 psi. See Bulletin 245.

A COMPLETE LINE FOR EVERY BUILDING SERVICE

NEW F-C AND C-C PUMPS EITHER FLEXIBLE-COUPLED OR CLOSE-COUPLED

Compact, smooth running, quiet, — ceramic faced seal is highly resistant to wear — for circulating and booster service. Heads from 10 to 190 feet, capacities from 5 to 400 gpm. Bulletins 107 and 108.

SURE-RETURN CONDENSATION PUMP AND RECEIVER

Low inlet — positive head on suction — no friction in manifold between pump and receiver—handles extremely hot condensate without steam binding — for systems to 75,000 EDR and low or medium pressures. See Bulletin 250.

Write to Department B

For additional information on any of the above pumps, specify by bulletin number.

fmc

CHICAGO PUMP COMPANY

Subsidiary of Food Machinery and Chemical Corporation

BUILDING PUMP DIVISION

400 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

Condo-Vac ®, Sure Return ®, AVC, LVC, Fire, House & Circulating Pumps, Pressure & Tankless Water Systems, Flush Kleen ® Sewage Ejectors, EDR Rated ® & Non-Clog Bilge Pumps. Pumps for every industrial use.

Cleaner air with half the filters

—reports large metropolitan library

Keeping hundreds of thousands of library volumes as dirt- and must-free as possible calls for quantities of clean, fresh air.

At one large library, they tried many types of filters —were using banks of two 1"-thick throwaway filters in series—to clean intake air. But the surfaces quickly clogged with dirt—operating costs became excessive. Then they tried PLIOTRON – the world's first truly washable, electrostatic, panel-type air filter.

They soon found single banks of PLIOTRON, 1" thick —*only half the number*—cleaned the air better, did not clog and were easily cleaned for repeated use. That's because the unique filter medium of PLIOTRON carries a permanent, electrostatic charge that actually attracts and captures up to five times as many fine dirt particles. It also permits depth-loading rather than surface-loading, and maintenance of full efficiency by simple washing.

PLIOTRON can bring cleaner air at lower cost and with less work to any forced-air heating or air-conditioning system using panel filters. For details see your PLIOTRON Distributor. Or write Goodyear, Pliotron Sales Dept. 722, Akron 16, Ohio.

PLIOTRON Air Cleaner by

GOODYEAR

Pliotron—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

THE GREATEST NAME IN RUBBER

Uses **LESS** space to heat **MORE** space

Back your bids with the compactness and fuel-thrifty efficiency of Mueller Climatrol gas-fired unit heaters

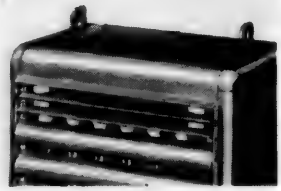
WITH quick, quality-name recognition and a whole host of design refinements, Mueller Climatrol gas-fired unit heaters lend convincing weight to contract talk. Just point out the features . . . the name speaks for itself.

QUALITY FROM BASE TO BRACKETS. Easily installed out of the way, Mueller Climatrol unit heaters with horizontal rear flue vent allow greater installation flexibility and headroom. Quick response to demands for heat is assured with either manual or automatic regulation, thanks to horizontal air tube construction of the heat exchanger which speeds heat transfer. Dependable safety controls . . . heavy-duty, corrosion-resistant cast iron drilled port burner — they're standard in all nine sizes from 25,000 to 225,000 Btu. Oil-fired models also available.

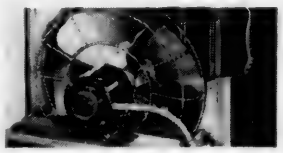
Write for the full story — see why clients respond to Mueller Climatrol quality. Now!

FIRST IN FEATURES

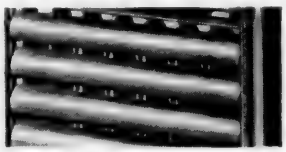
LONG LIFE
Deep burner pouch allows even heat distribution over entire exchanger area with no direct flame impingement. No welded joints in hot gas zone or path of flue travel.



EASY TO INSTALL
Hanger brackets provide easier hoisting into hard-to-get-to positions — providing more headroom where it's needed. Easy to adjust, service.



EFFICIENT CIRCULATION
Has special high efficiency, four-blade propeller type fan, dynagraphically balanced for quiet even delivery. Blower styles available.

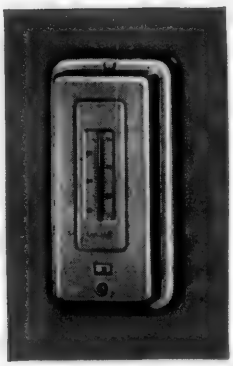


CORRECT DISTRIBUTION
Louvres can be adjusted to direct heat in any direction required to maintain correct comfort level, without hot blasts. Design insures uniform air distribution.

See your man from

Mueller Climatrol®

Dept. 96, 2060 W. Oklahoma Avenue, Milwaukee 15, Wisconsin



Symbol of Economy and Quality Control

POWERS Control System Used in Chicago's Largest Apartment Building

Now nearing completion is this outstanding 10 million dollar building with its 662 luxury apartments. It has three 23 story towers with a panoramic view of Lincoln Park and Lake Michigan.

Heating, ventilating, domestic hot water, fuel oil preheaters and snow melting for walks and driveways are all thermostatically controlled by Powers.

The forced hot water heating system is regulated by a Powers indoor - outdoor Mastrol system. Supply and exhaust fans serving corridors, bathrooms, kitchens, offices, garage and other spaces are also Powers controlled.

When you have a temperature control problem why not benefit from Powers experience gained here, and in thousands of other prominent buildings.

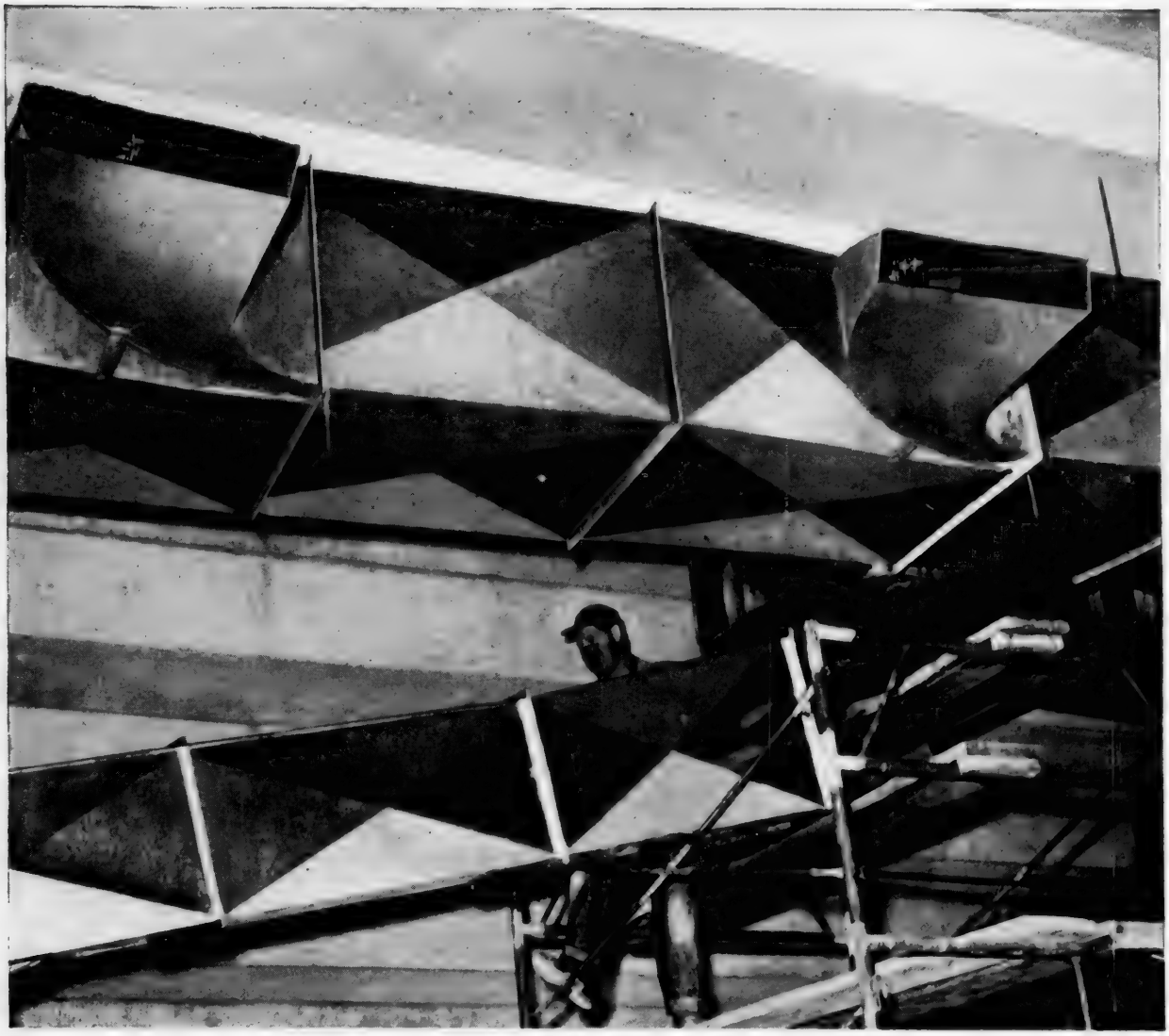
For further information contact our nearest office.

THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in Chief Cities in U.S.A., Canada and Mexico See your phone book*

65 Years of Automatic Temperature and Humidity Control

(c78)



This coating goes wherever the base metal goes

You can put Bethcon galvanized steel sheets through the toughest kind of forming without flaking or peeling of the zinc coating. Snap locks, Pittsburgh locks, or your own special seams—they're all the same to a Bethcon sheet!

That's because Bethcon is galvanized in Bethlehem's continuous lines, which bond the zinc more tightly to the base metal than conventional hot-dipping processes. With a Bethcon sheet, you'll find that the coating goes wherever the base metal goes and comes out just as sound as it started.

There's another advantage in Bethcon, too: the improved appearance and sales appeal of the finished product. Bethlehem's continuous galvanizing process imparts brighter, more uniform spangles to the sheet. It also distributes the zinc more evenly over the surface, eliminating those heavy beads which you so often find on the drip end of conventional galvanized sheets.

You can specify Bethcon in cut lengths or coils, 16-gage or lighter. You can also choose between plain carbon steel and corrosion-resisting Beth-Cu-Loy (copper-bearing steel) for the base metal, depending on the requirements. If you would like more details about Bethcon, our nearest district office will be glad to make them available.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

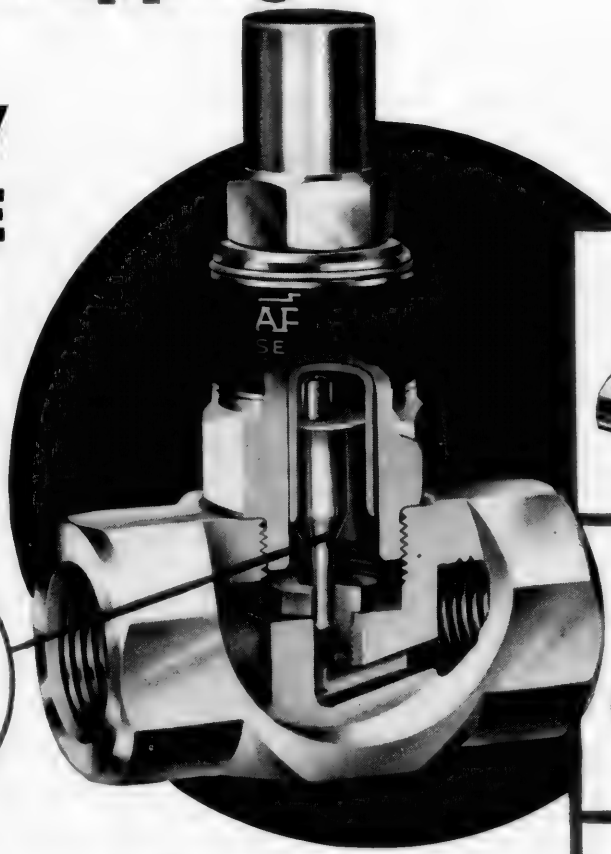
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

the impulse that revolutionized steam trapping

YARWAY IMPULSE STEAM TRAP



the only moving part

...a small stainless steel valve that literally floats on the condensate load. Gets equipment *hot in a hurry*—and *keeps it hot!*

SERIES 60 and 120

For all *normal* trap requirements, pressures to 400 and 600 psi.

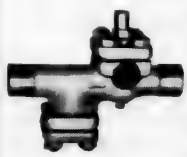
½" No. 20-A

For *light loads* on tracer lines, steam mains, small presses, etc.

SERIES 40

For *heavy loads* requiring extra high capacity steam traps.

INTEGRAL-STRAINER HIGH PRESSURE TRAP



For *high pressures, high temperatures.* (Flanged or welding connections.)

Twenty years ago YARWAY applied a unique theory of thermodynamics to steam traps—and gave industry the amazing YARWAY Impulse Steam Trap.

Today—over a million YARWAY Impulse Steam Traps later—advantages like the following continue to convert new users, and convince old users to standardize on the YARWAY Impulse:

- **QUICK HEAT-UP AND EVEN TEMPERATURES OF EQUIPMENT**
- **GOOD FOR ALL PRESSURES WITHOUT CHANGE OF VALVE OR SEAT**
- **SMALL SIZE—LIGHT WEIGHT**
- **ONLY ONE MOVING PART**
- **STAINLESS STEEL—minimum maintenance**
- **WON'T FREEZE UP**
- **A COMPLETE LINE of sizes and types for every requirement**
- **IMMEDIATELY AVAILABLE from 270 local Industrial Distributors**

For free Trap Selector, or 24 page Bulletin, write

YARNALL-WARING COMPANY
104 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY IMPULSE® STEAM TRAP

OVER 1,000,000 YARWAY IMPULSE STEAM TRAPS USED

Salt Lake City's First Security Bank building shows how

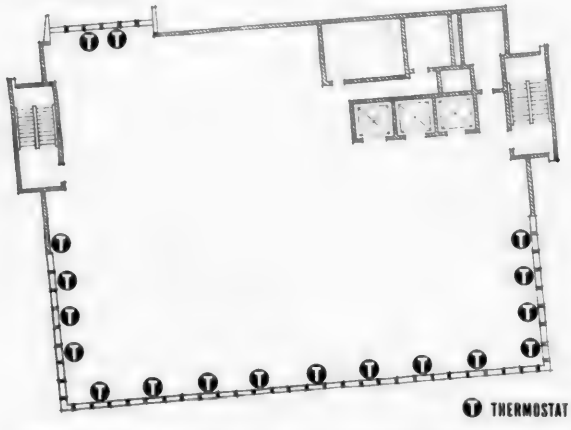
Honeywell can help assure

First Security Bank building, Salt Lake City, Utah. Designed by Bank Building Corporation of America. Associate architect: Slack W. Winburn. Mechanical and electrical engineer: Ferris & Hamig. General contractor: Utah Construction Company. Mechanical contractor: Larsen & Company.

ideal indoor weather for your clients

Exposure is no problem with a Honeywell Customized Temperature control installation. Accuracy and quick response of Honeywell thermostats keep comfort constant despite changing conditions of wind and sun—even in offices like this, where glass is used freely.

Use of space helps determine control needs. Number of people in the bank varies at different times; so does the type of work done. Strategically placed Honeywell thermostats call for exact amounts of heating, cooling or ventilating needed under all conditions.



Thermostats are placed to give individual control to exterior offices that will be partitioned according to tenants needs. Interior office spaces will be controlled by separate zone thermostats.

Honeywell Customized Temperature Control compensates for exposure, weather changes and office layout

IN THE best modern construction, indoor weather is planned with as much care as the building itself.

When this happens—and it happens often—you're likely to find the building has a Honeywell Customized Temperature Control installation.

That's the case in the new quarters of Salt Lake City's First Security Bank. Here, Honeywell provides flexible temperature control to meet the needs of owners and upper-floor office tenants. At the same time the ground-floor banking area is supplied with indoor weather that's ideal for clients, customers and employees. Efficient working conditions are maintained throughout the air-conditioned building.

That's what "customized" means—a control installation fitted to the needs of the building and its occupants, in heating, cooling, ventilating and humidity control.

True customized control can best be provided by Honeywell. Because only Honeywell manufactures all three types of controls—pneumatic, electric and electronic—which permits Honeywell to make truly objective recommendations.

Whether it's an office building, factory, bank or store—any building of any size, new or existing—Honeywell Customized Temperature Control can help solve your client's problems of heating, ventilating, air conditioning and industrial control.

For full details on Honeywell Customized Temperature Control, and the economical Periodic Maintenance Plan, call your local Honeywell office. Or write Honeywell, Dept. HV-9-90, Minneapolis 8, Minn.

MINNEAPOLIS
Honeywell

Customized Temperature Control

112 offices across the nation

Guaranteed TO SHUT TIGHT*

*When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

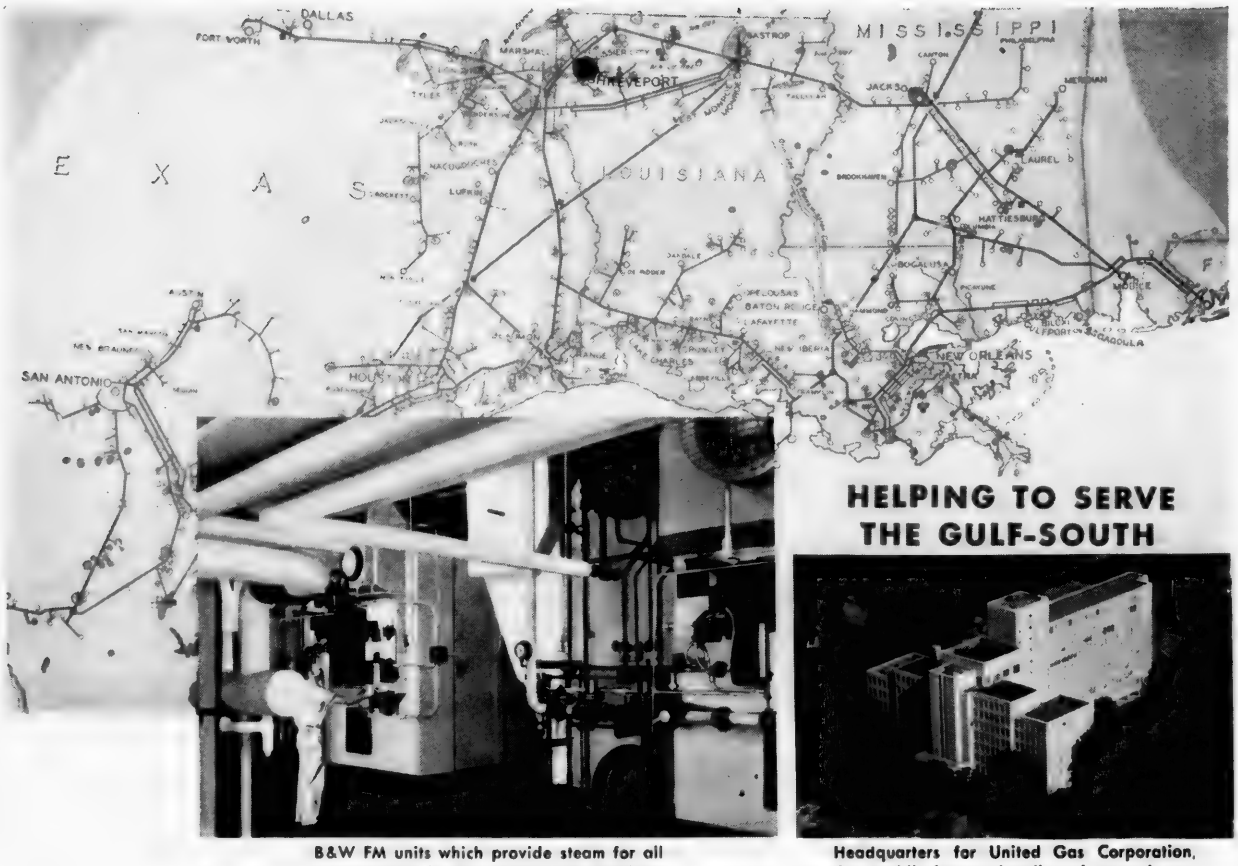
These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.

SPENCE
TYPE ET150
Temperature
Regulator

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK



HELPING TO SERVE THE GULF-SOUTH

B&W FM units which provide steam for all requirements in the United Gas Building.

Headquarters for United Gas Corporation, the world's largest handler of natural gas.

B&W FM Boilers Provide Steam for AIR CONDITIONING • HEATING

United Gas Building

United Gas Corporation and its subsidiaries of Shreveport, Louisiana, one of the largest systems of its kind in the world, supplies natural gas to a large and growing part of the southern section of the United States —the "Gulf South". And when the installation of modern heating and air conditioning facilities in the company's Shreveport headquarters building was being studied, the same careful consideration applying to other phases of the company's far flung operations was given to the selection of boilers. As other users have done, United Gas chose two B&W FM Units for a reliable and economical steam source.

In the newly enlarged United Gas Building, the FMs supply the heating load during the winter and steam for the much heavier summertime air-conditioning load. They are gas-fired and designed for manual or semi-automatic operation. Each boiler is designed to generate up to 11,000 lb of steam per hr at an operating pressure of 160 psi. Since their installation in August 1953, the FM Units have provided completely satisfactory service, efficiently and economically.

B&W FM Boilers are available in standard sizes to 40,000 lb of steam per hr at pressures to 235 psi. Many are also in service at higher pressures and with moderate superheat. Write for Bulletin G-76 for complete details. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

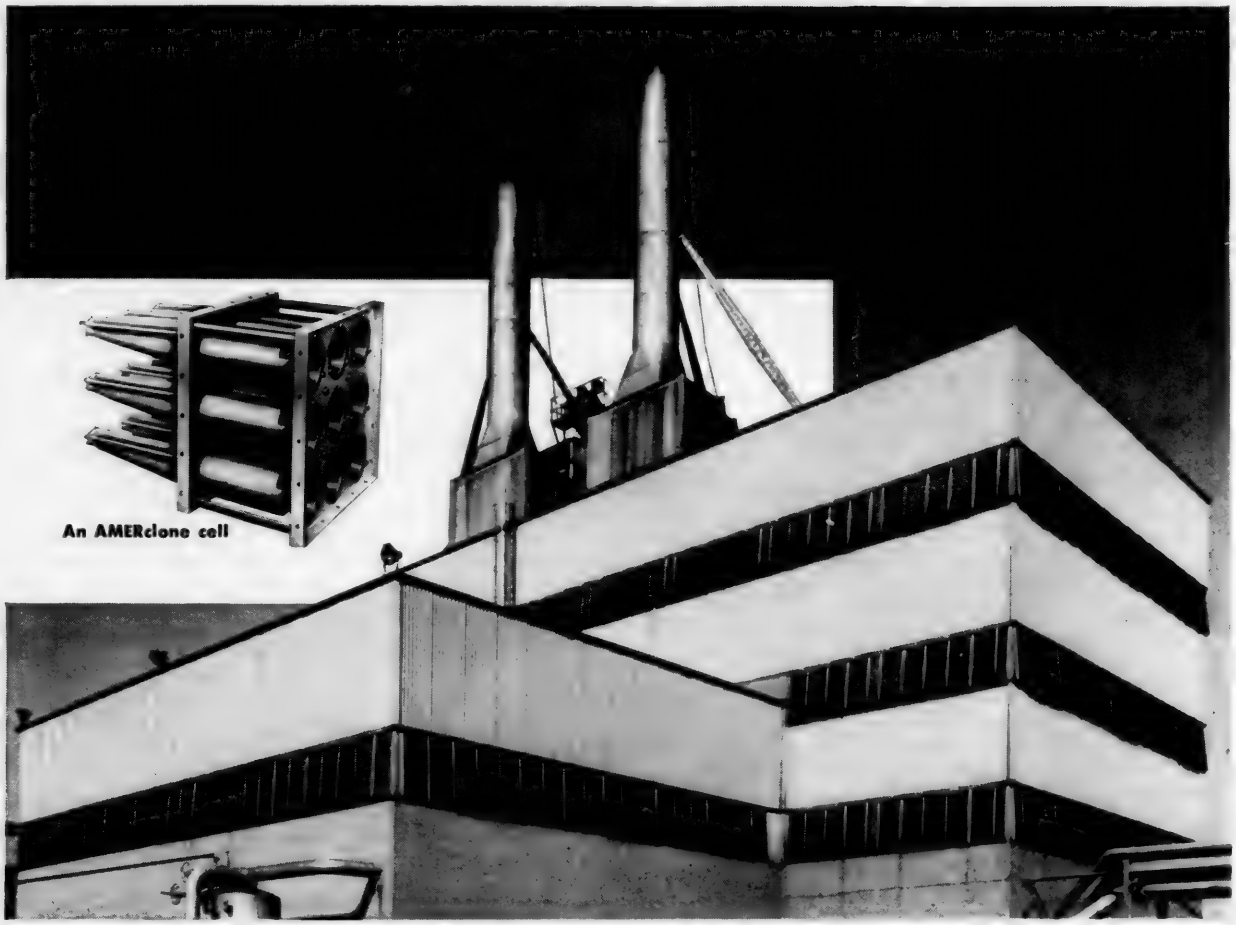
G-744

FMs Offer These COST-SAVING FEATURES

- Save Erection Time and Cost
- Meet Wide Range of Service
- Handle Quick Load Changes
- Suitable for Outdoor Service
- Safe, Automatic Operation
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Burn Oil and/or Gas
- Save Fuel
- Save Space

BABCOCK & WILCOX

BOILER DIVISION



An AMERclone cell

Both of the boilers at this Southern foundry were in operation when this photograph was taken. Note absence of any visible stack effluent.

AMERClone traps 5 TONS of fly ash DAILY!

Atmospheric Nuisance Eliminated by AAF Dust Control

Boiler fly ash that formerly "went up in smoke" (only to reappear on parking lots and the surrounding neighborhood) has disappeared from the scene at this Southern foundry. An AMERclone system on each of two boilers puts this menace in its place—in the dump, where it can do no harm.

AMERclone does the job, thoroughly . . . operates at 92% efficiency *at all times,* even though boiler room requirements fluctuate as much as 30% in any 24-hour period. High collection efficiency and maintained efficiency are just two of the dollars-and-cents advantages of AMERclone. This dry centrifugal requires less space than comparable units because each 20" x 20" cell (see inset in photograph) has a rating of 3,000 cfm! And the abrasive fly ash has little or no effect on AMERclone's tough, thick-wall gray iron castings.

Don't let a few tons of dust per day stand between you and better working conditions, better community relations. Get all the facts on AMERclone. Call your local AAF representative or write direct for Bulletin 291.

AAF Filters and Precipitators

Illinois Steam Heating Specialties

AAF American Air Filter COMPANY, INC.
294 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

BETTER AIR IS OUR BUSINESS

Herman Nelson Unit Heaters

Herman Nelson Unit Ventilators

To the ENGINEER with a . . . TOUGH CORROSION PROBLEM

Novelty offers the engineering and fabricating facilities of the Novelon Lining Department. The latest advancements in linings of plastic, rubber, lead, copper and cement are available to answer tough corrosion problems in storing and processing water, acids, beverages, foods and most chemicals.

Let Novelty's combination of 50 years of fabricating vessels and the most advanced lining facilities be your assurance of selecting and building an enduring vessel. Write, telegraph or telephone your problem — today!

Write today on your company letterhead for reference catalog.

"Specify NOVELON LININGS"

NOVELTY

STEAM BOILER WORKS, INC.

FIFTY YEARS OF FABRICATING UNFIRED PRESSURE VESSELS

HOT WATER GENERATORS

STORAGE TANKS

SPECIAL LININGS

SPECIAL FABRICATION

NOVELTY STEAM BOILER WORKS, INC.

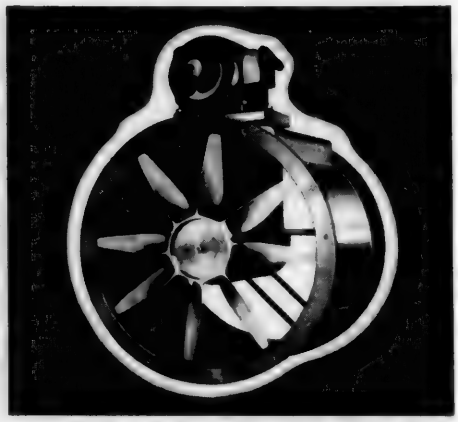
2031 KLOMAN STREET • PHONE PLAZA 2-0425 • BALTIMORE 30, MARYLAND

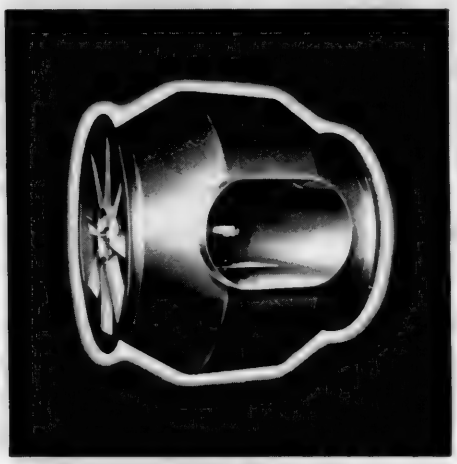
SUBSIDIARY OF ELLICOTT MACHINE CORPORATION

there's a HARTZELL fan or blower to power any ventilating system

Hartzell Duct Fans

Say good-by to high installation and maintenance costs when you choose a Hartzell Duct Fan. Built as a prefabricated duct section, it bolts into place easily in any duct system, leaving the motor readily accessible for maintenance. This rugged and reliable fan fits any duct system for removal of flammable fumes, corrosive elements, or abrasive dust. Sizes from 12″ to 60″ in both belt-drive and direct-drive models.



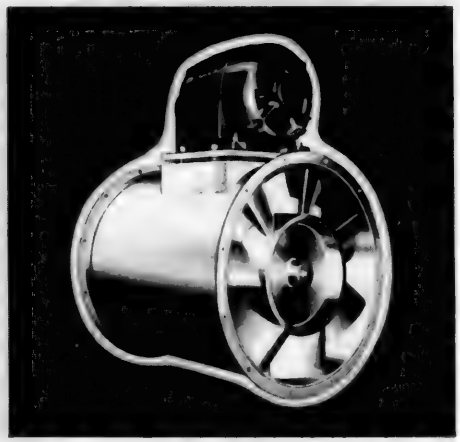


The *NEW* Hartzell Bi-Pass Duct Fan

Here is the ideal fan for high temperature operations such as ovens and oil and gas fired induced draft boilers and for moving corrosive fumes. Designed with the motor mounted in a tunnel out of the air stream, the Bi-Pass Duct Fan is available in diameters from 19″ to 41″. Operates in temperatures to 300° in standard construction, to 550° with special high-temperature, heavy duty construction.

Hartzell Vaneaxial Blowers

These rugged units are designed for trouble-free performance and long life in punishing industrial applications. All welded, heavy gauge steel construction. Ten belt drive sizes, 12″ to 54″, six direct drive sizes, 18″ to 42″. The new High-Temperature model moves air at temperatures up to 350° or air containing acids and alkalies without danger of premature failure of the belt or bearings. Other models operate efficiently against pressures as high as 10″ water gauge.



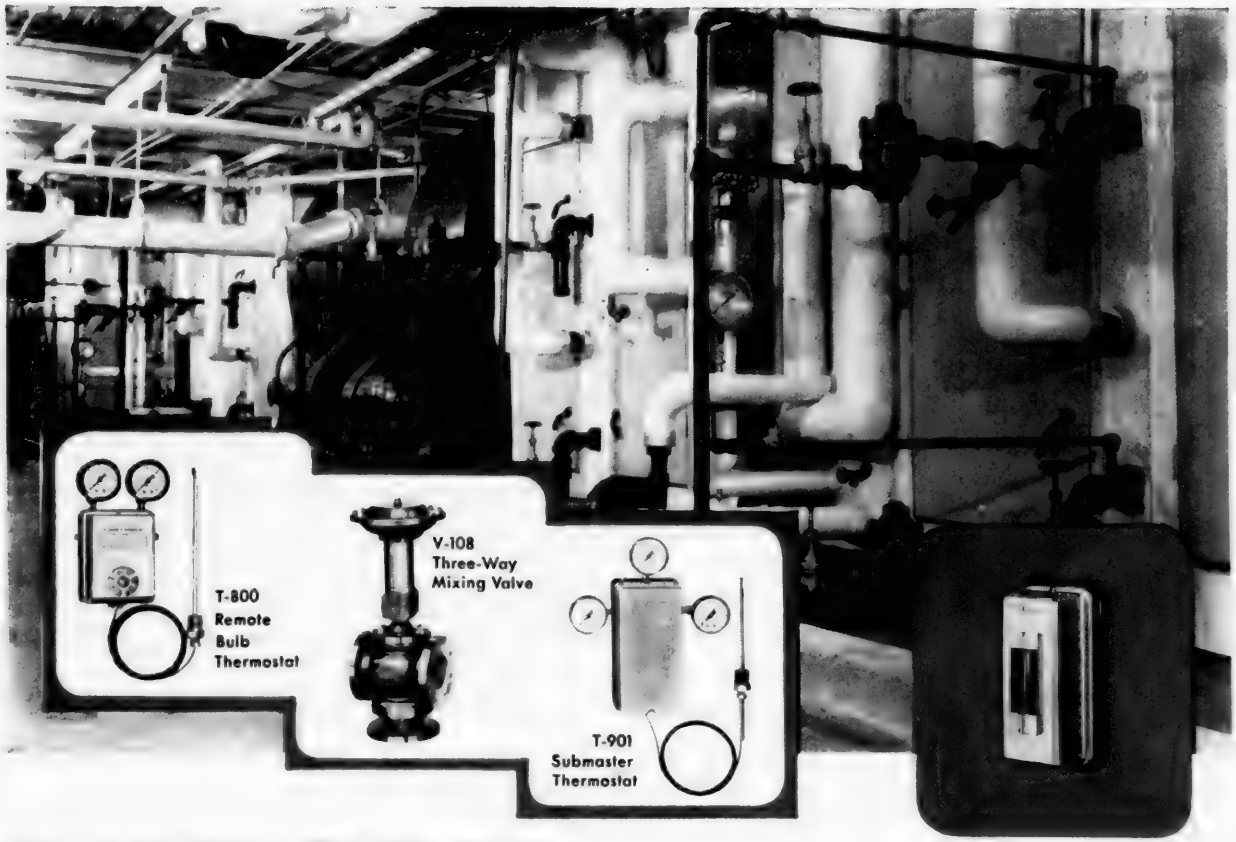
HARTZELL

Please send me details on
☐ Hartzell Duct Fans ☐ Vaneaxial Blowers
☐ The new Bi-Pass Duct Fan

propeller fan co.
Div. of Castle Hills Corp.

Name _____
Company _____
Street & Number _____
City & State _____
If student, check here for special information ☐

303 Herrman Avenue
PIQUA, OHIO
PROPELLER-TYPE FANS • BLOWERS
ROOF VENTILATORS • UNIT HEATERS
ENGINEERING OFFICES IN PRINCIPAL CITIES



How Collins Radio gets Precision, Waste-Free Air Conditioning Performance

A creative force of over 750 engineers, technicians and supporting staffs occupy the impressive new engineering and research building of Collins Radio Company.* Design, layout and equipment have been skillfully combined to produce a completely controlled environment for each of the varied research and development activities of Collins personnel.

A key feature of this modern controlled environment is a specially designed system of Johnson Air Conditioning Control. Johnson Thermostats, Valves, Dampers and other apparatus regulate the operation of eight central fan air conditioning units and related equipment to meet the special needs of each section of the building. Whether it's one of the large general office areas, a conference room, test area, laboratory, library or the cafeteria-auditorium, ideal temperatures prevail at all times.

By engineering and installing each of its control systems to meet the exact needs of the individual building and its particular mechanical equipment, Johnson offers the dual benefits of perfectly regulated temperatures and virtually waste-free heating and cooling operation.

Johnson Pneumatic Control combines the adaptability, accuracy, and economy to solve *any* problem of heating, cooling, ventilating, air conditioning or process control. Johnson engineers know and understand thoroughly the special control problems of industry.

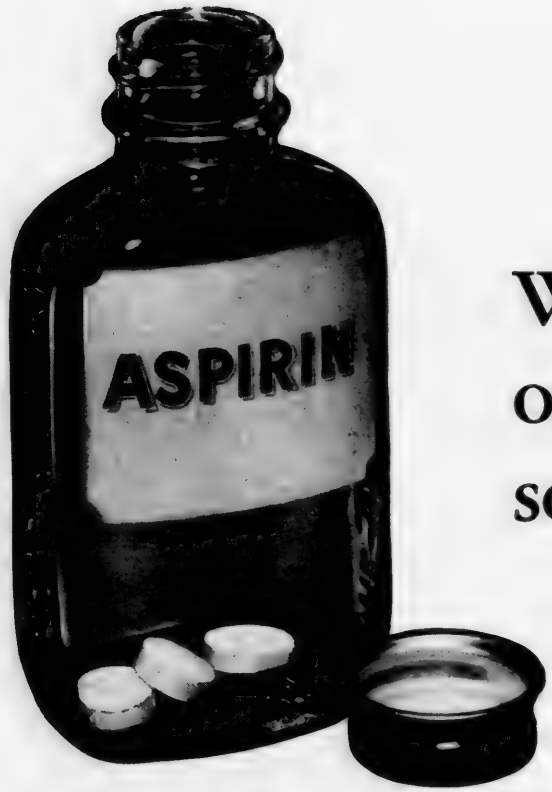
Whether your problems involve comfort control or the provision of protective temperatures and humidities for products and processes, talk them over with a nearby Johnson engineer. His advice is yours without obligation. Johnson Service Company, Milwaukee 1, Wisconsin. Direct Branch Offices in Principal Cities.

*Engineering and Research Building, Collins Radio Company, Cedar Rapids, Iowa. Abell-Howe Company, architects & builders, Chicago; Samuel R. Lewis & Associates, mechanical engineers, Chicago; J. W. Darragh, Inc., mechanical contractor, Cedar Rapids.

JOHNSON CONTROL

SINCE 1885

PLANNING • MANUFACTURING • INSTALLING



We had our headaches so you wouldn't!

The AAF *Roll*-O-MATIC air filter features *built-in* trouble-free operation

THE idea of the Roll-O-Matic air filter seemed simple enough. The *idea* was . . . but development and perfection *were not*. The goal of positive automatic operation plus simple, once-a-year maintenance offered some thorny problems.

To reach that goal, AAF developed Roll-O-Mat—the "miracle" filtering material of fluffy, bonded glass fibres that compresses to paper-like thinness on the roll. That's not all. The Roll-O-Matic also required a specially-compounded viscosine (for pre-charging media) that retained its jelly-like consistency under a wide range of temperature and humidity conditions . . . without being sticky to handle on the roll.

Your response to the AAF Roll-O-Matic has proven that it's worth a lot of headaches to be able to offer a headache-free air filter. For complete details on the *one-and-only* Roll-O-Matic, call your nearest AAF representative or write direct for Bulletin 248A.

AAF American Air Filter COMPANY, INC.

294 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

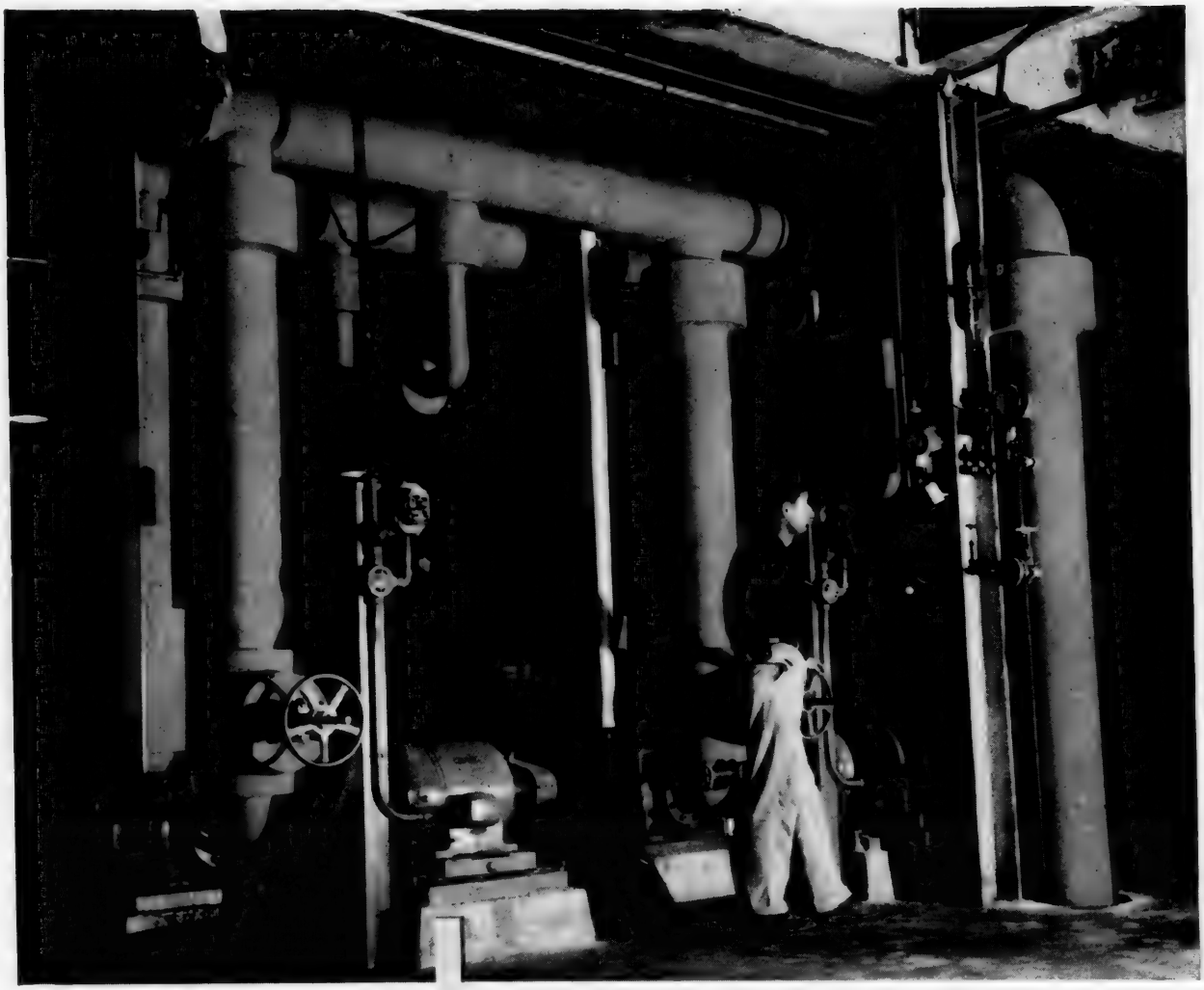
AAF Dust Control Equipment

Illinois Heating Specialties

— BETTER AIR IS OUR BUSINESS —

Herman Nelson Unit Heaters

Herman Nelson Unit Ventilators



Specify GUSTIN gb BACON SNAP*ON *for good and fitting reasons*

Plant piping takes on this trim, tailored look — and in record time — when you insulate with G-B Snap*On, the one-piece molded pipe insulation of fine glass fibers. From ¾" through 33" IPS and in 3' and 6' sections depending on pipe size. With just a pocket knife and a stock of Snap*On in nesting sizes, *anyone* can make easy work of the once-tedious job of insulating bends, valves and other fittings.

To fully understand why this material saves so much time and money on fittings and straight runs you need only handle a 6-foot section of Snap*On. It's flexible, yet resilient. It's feather-light, yet tough. It's almost impossible to damage, yet easy to cut with a knife. And to these obvious advantages, you can add such unseen benefits as *permanence* and the *highest thermal efficiency of any pipe insulation on the market.*

Next time you have hot or cold piping to insulate, call your nearby distributor, listed in the Yellow Pages under "G-B Insulations." In the meantime, write today for our new 8-page brochure with full details on "the first all-new pipe insulation in 60 years."

GUSTIN-BACON *Manufacturing Company* GUSTIN gb BACON

Thermal and acoustical glass fiber insulations • Pipe couplings and fittings • Railroad gaskets and supplies.

222 W. 10th St., Kansas City, Mo.

This Crane valve at Imperial Sugar has a sweet performance record

Six years of trouble-free performance are behind this Crane valve. It's a No. 353 12-inch iron body angle pattern.

Since 1949, this valve has been on 10 to 15 psi. steam service at 350° F., in the Imperial Sugar Co. refinery at Sugar Land, Texas—with no leakage, no service repairs, no maintenance of any kind. The valve is operated 2 or 3 times a week. Today, closure is just as tight and sure, and operation as easy and smooth, as the day it was installed.

Actually, this is only an average performance record for Crane valves on steam service. Every dimension, every design feature built into these rugged valves is precision-engineered for years and years of trouble-free operation.

It's just good sense not to take chances in selecting valves for steam service. Specify Crane and make sure you're getting the best valves made—backed by the world's greatest experience in the valve field, with the broadest line of all to choose from and the finest materials available today. Get full information from your local Crane Representative, or write to the address below.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

THE MARK OF QUALITY

BARBER COLMAN

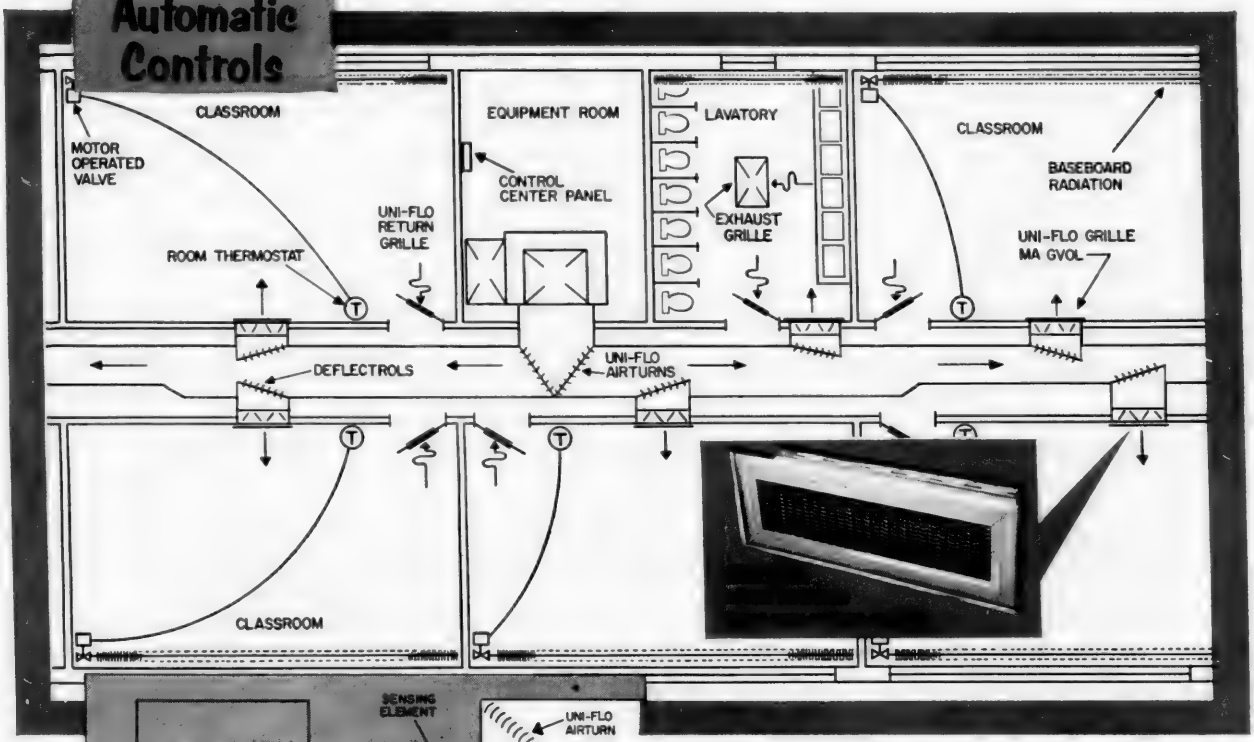
uni-flo

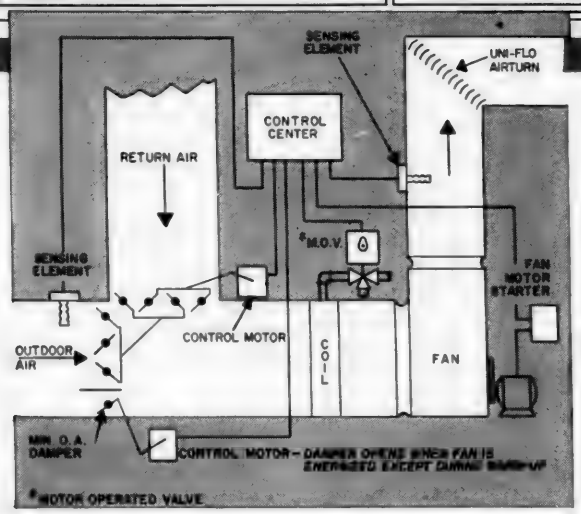
ENGINEERED AIR DISTRIBUTION

ELECTRIC-ELECTRONIC

Automatic Controls

How Barber-Colman *combined skills* help you get best results with "split-system" heating and ventilating



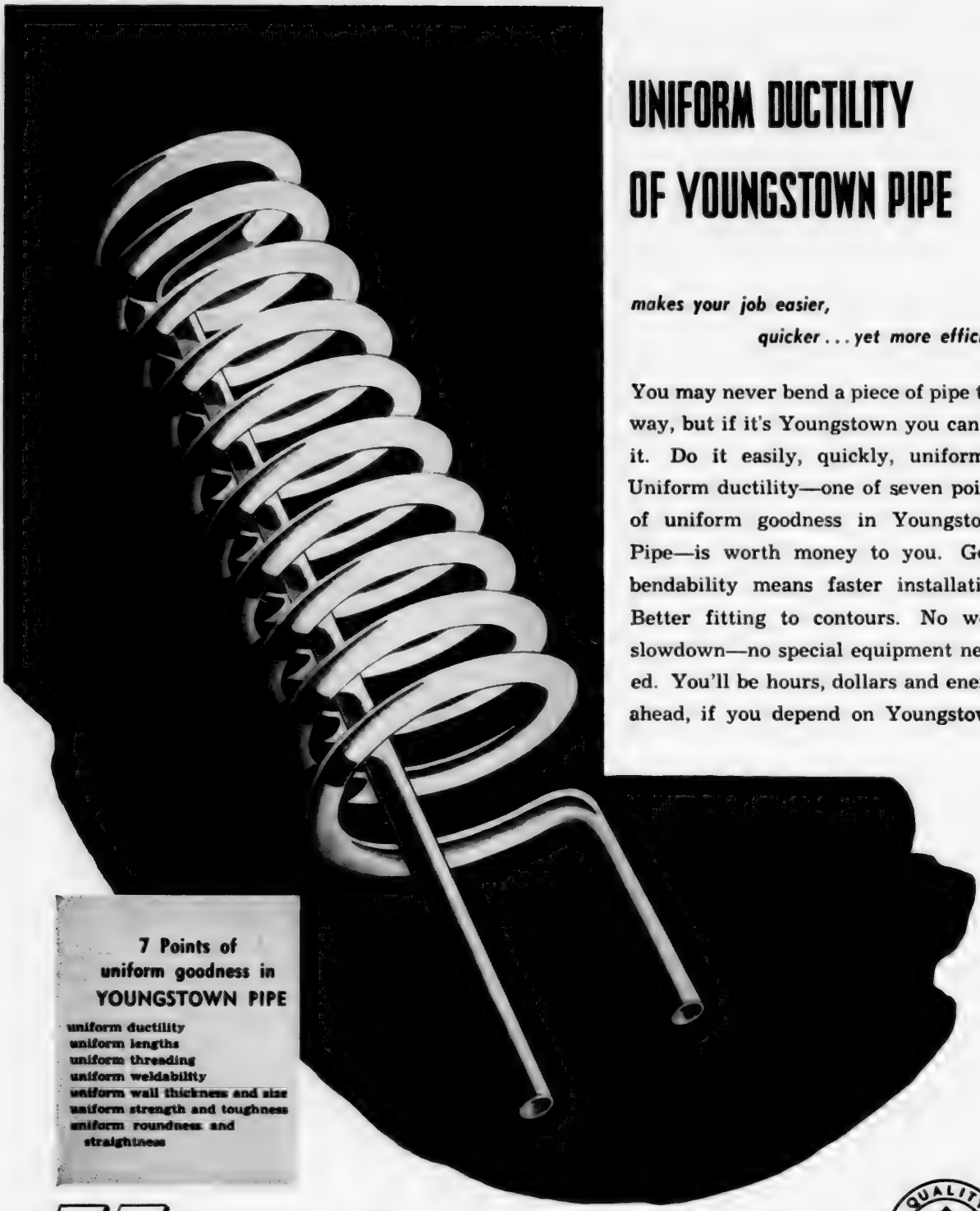


Air handling unit, controlled by electric-electronic Control Center.

Single-manufacturer responsibility and combined skills in both air distribution and automatic controls are available only at Barber-Colman. They help you insure superior comfort and health conditions with the highly flexible "split system." Heat losses are offset with radiation controlled by fast-acting electric thermostats governing motor-operated valves in the hot water supply line. A compact electric-electronic Control Center controls ventilation to provide tempered air by positioning outdoor and return air dampers, and heating coil valve in sequence. Cooling is provided through use of outdoor air. Uni-Flo MA Double Deflection Sidewall Diffusers provide maximum aspiration and complete control of air discharge without "air drop." Efficiently designed Airturns and Deflectrols help assure uniform air supply at all diffusers. The combined efficiencies of the electric-electronic control system and proper air diffusion permit the maximum use of outdoor air for cooling in schoolroom ventilation. Phone your nearby Barber-Colman Field Office or write for details.

COME TO ONE SOURCE . . . COME TO . . . **Barber-Colman Company**

DEPT. I, 1602 ROCK STREET, ROCKFORD, ILLINOIS, U. S. A.



UNIFORM DUCTILITY OF YOUNGSTOWN PIPE

makes your job easier,
quicker . . . yet more efficient

You may never bend a piece of pipe this way, but if it's Youngstown you can do it. Do it easily, quickly, uniformly. Uniform ductility—one of seven points of uniform goodness in Youngstown Pipe—is worth money to you. Good bendability means faster installation. Better fitting to contours. No work slowdown—no special equipment needed. You'll be hours, dollars and energy ahead, if you depend on Youngstown.

7 Points of uniform goodness in YOUNGSTOWN PIPE

- uniform ductility
- uniform lengths
- uniform threading
- uniform weldability
- uniform wall thickness and size
- uniform strength and toughness
- uniform roundness and straightness

Youngstown PIPE

QUALITY YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

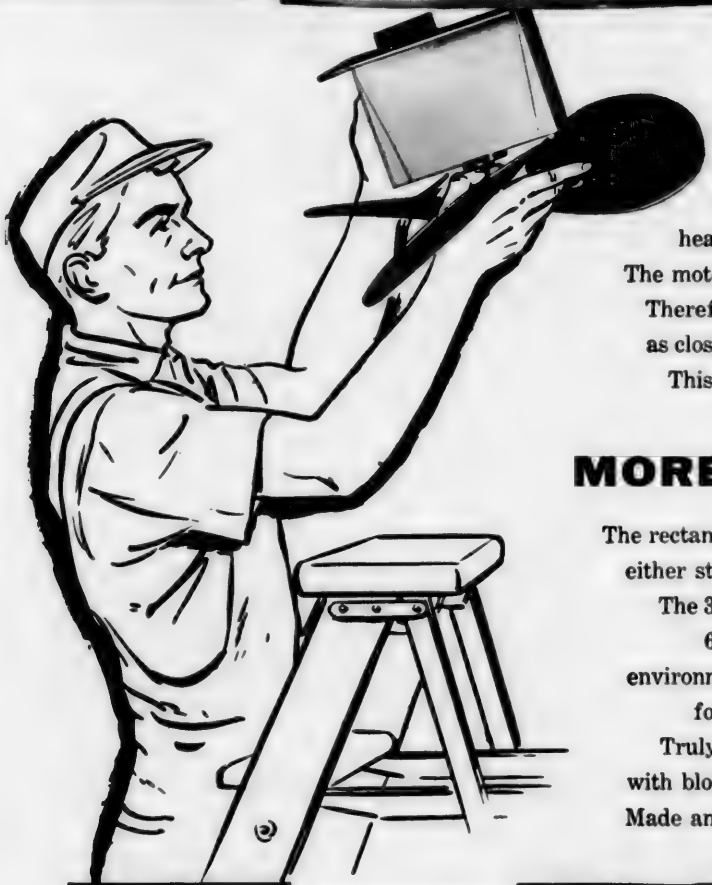
Manufacturers of Carbon, Alloy and Yoloy Steels

General Offices Youngstown, Ohio District Sales Offices in Principal Cities

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - WIRE - HOT ROLLED RODS - COKE - TIN PLATE - ELECTROLYTIC TIN PLATE - BLACK PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

The Nesbitt Little Giant Unit Heater

MOUNTS CLOSER TO THE CEILING

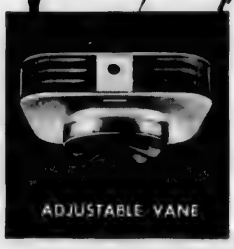


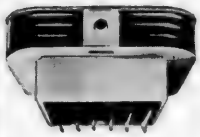
MORE ACCESSIBLE

Two male pipe connections extend from square steel headers on opposite sides of the Little Giant. The motor and fan are removable through outlet at bottom. Therefore, all access is from below; Little Giants mount as close as 1 inch (not more than 3 inches) from ceiling. This means maximum headroom on any type of system.

MORE ADAPTABLE

The rectangular wrap-around heating element operates with either steam or hot water, in vertical or horizontal position. The 34 unit models offer capacities ranging from 34,000 to 684,000 Btu per hour—sound rated (IUHA) for the environment they serve — with a wide variety of outlets for air distribution and mounting height as desired. Truly, Little Giants are the "propeller-fan unit heaters with blower-fan performance." See Publication 402. Made and sold by John J. Nesbitt, Inc., Philadelphia 36, Pa.


ADJUSTABLE VANE


VERTICAL LOUVER

HORIZONTAL LOUVER

CONE DEFLECTOR

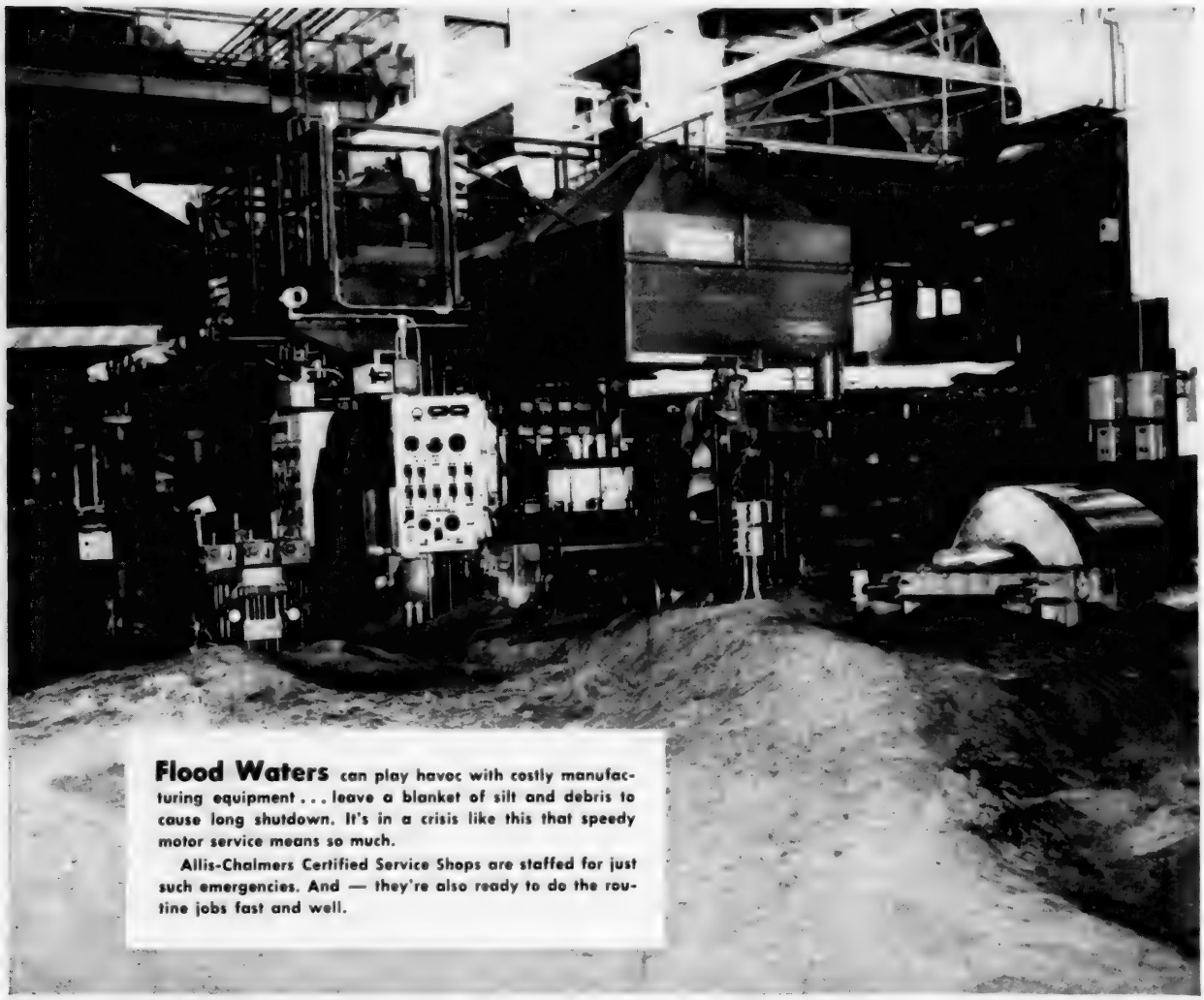
ANEMOSTAT OUTLET

THE NAME TO GO BUY IN UNIT HEATERS

Nesbitt

Allis-Chalmers "Certified" Service Shops:

When you need motor help



Flood Waters can play havoc with costly manufacturing equipment . . . leave a blanket of silt and debris to cause long shutdown. It's in a crisis like this that speedy motor service means so much.

Allis-Chalmers Certified Service Shops are staffed for just such emergencies. And — they're also ready to do the routine jobs fast and well.

Catastrophe or Routine Service

Whether it's complete catastrophe or a normal repair job, fast motor service can make a difference of thousands of dollars in lost production. As near as your phone is one of more than 100 Allis-Chalmers Certified Service Shops — ready to help save you production dollars.

These shops have manpower and equipment to perform repairs to Allis-Chalmers rigid standards. Their ability and integrity have been proven by years of service. They can do a good, fast job on any motor or generator, of any make. To locate the Shop in your area, call your nearby A-C district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.

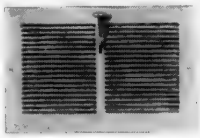
ALLIS-CHALMERS

A-5140

sure signs of indoor comfort!

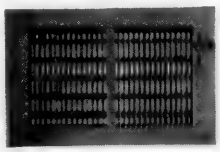
Standard Registers & Grilles

. . . for custom control of warm air heating



#41 H
WALL

SINGLE DAMPER FORCED AIR REGISTERS



#331
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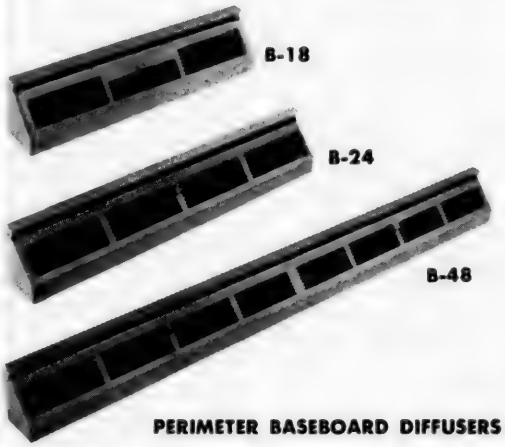
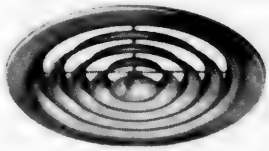
MULTIPLE VALVE SIDEWALL & BASEBOARD REGISTERS



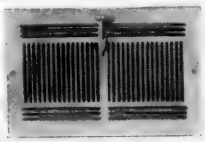
PERIMETER BASEBOARD DIFFUSERS

. . . for uniform, year-around heating and cooling comfort



CEILING AIR DIFFUSERS (flush and extended)

PH SERIES PERIMETER FLOOR REGISTERS



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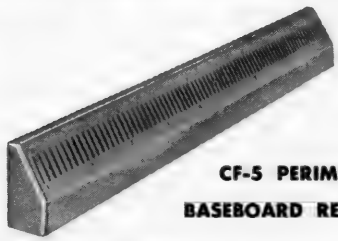
PERIMETER BASEBOARD REGISTER NO. 551



CF-5 PERIMETER BASEBOARD REGISTERS

Also: return air grilles, baseboard and sidewall intakes, air cond. and ventilating returns, door grilles, floor registers, cold air faces, frames, ornamental metals.

Install Standard Registers and Grilles on every job to save time and increase customer satisfaction.

STANDARD STAMPING

. . . first in engineering for indoor comfort!

Mail the coupon today for new FREE catalog!

Standard Stamping & Perforating Co.
3141 W. 49th Place, Chicago 32, Illinois

Gentlemen: Please send me your new catalog showing the complete line of Standard Stamping Registers and Grilles.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

You can expect

MORE COMFORT PER FUEL DOLLAR

from Modine UNIT HEATERS

Comfort-economy zone

Outlet air temperatures, velocities and volumes are *correctly related* in Modines for maximum comfort at reduced fuel costs. *Exclusive* Modine velocity generator produces penetrating heat throw, cuts through cold air strata near floor . . . improves overall heating efficiency.

Horizontal delivery type, direct pipe-suspended, can be installed as recessed or fully concealed unit.

Modine horizontal unit heaters

Built for steam and hot water service, units are available in blow-through and draw-through types . . . in 36 different capacities.

For drying and processing applications, hot water units with higher fin-to-tube ratios may be operated on steam.

Special Modine HCR high-corrosion-resistance premium models are available where resistance to internal corrosion is a problem.

Vertical delivery type. Light weight unit installs easier without special ceiling supports.

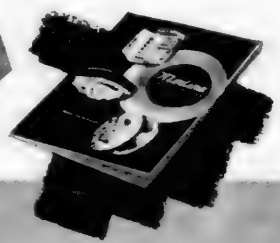
Modine vertical unit heaters

Offered in 26 different models each with choice of 4 types of air deflectors. Compact design permits ceiling mounting above craneways. Optimum fin spacing minimizes condenser clogging, especially where excessive foreign material is present in atmosphere.

SU-1322

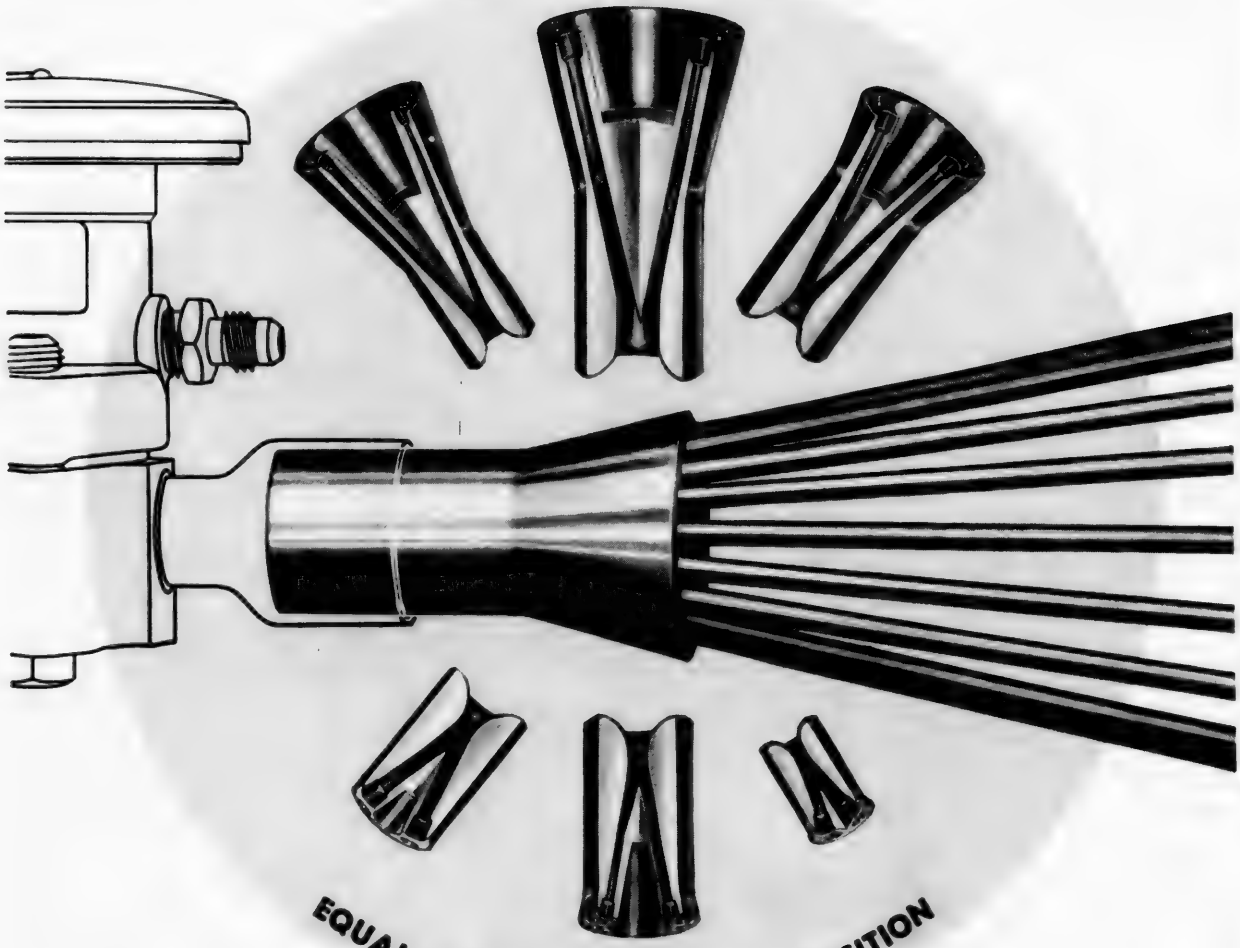
Write for free Bulletin 155

Gives you complete unit heater details. Write Modine Mfg. Co., 1511 DeKoven Ave., Racine Wis.



Modine UNIT HEATERS

In Canada: Sarco, Ltd., Toronto



one-piece ALCO venturi-flo distributor

Low pressure drop—Permits closer, more economical thermo valve sizing.

Wide application range—from 25% of capacity to 150% of rated capacity.

One-piece—No nozzles or orifice plates to stock and install.

One Venturi-Flo replaces distributors requiring as many as 6 or 7 nozzles!

Easy to select—No nozzles to size.

BUY QUALITY—BUY ALCO WRITE FOR BULLETIN 188-55

SEE YOUR ALCO WHOLESALER

ALCO VALVE CO.

859 KINGSLAND AVE. • ST. LOUIS 5, MO.

Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

7043

Operating Engineer Claude Rogers is inspecting an old trap that was installed in the LaSalle Hotel, Chicago, in 1909—before he was born! That's 47 years of service, and it's still operating. It's one of 62 old Illinois Engineering "Automatic Float-type Vacuum" traps still doing a job there.

Some of the traps were replaced in 1952, after 43 years of duty. But—mark this—*the LaSalle always replaces the original traps with new Illinois Float and Thermostatic Traps.* And the LaSalle's new heating-air conditioning system has *only Illinois* traps.

Reasons: More years of trouble-free service than you'd ever expect . . . No maintenance problems with Illinois' simple, solid design . . . probably the most efficient system of condensate drainage yet devised for heating systems . . . Straight-through connections to save head room and labor.

For real *durability* and efficiency in a Float and Thermostatic trap, take a hint from the LaSalle Hotel's 47-year-old Illinois installation and hundreds more like it. Specify Illinois Series G Float and Thermostatic traps for low and medium pressure steam jobs from 15 lbs. pressure to 25 inches vacuum. Series MG to 50 lbs. pressure. Available in sizes from ¾" to 2". Send for Bulletin 251 *now.*

illinois
ENGINEERING

Illinois Engineering Company

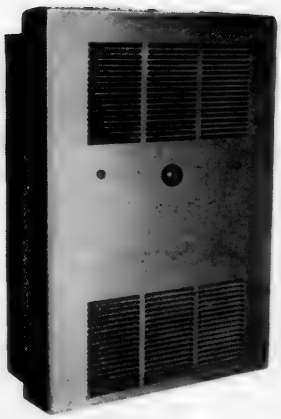
2025 S. Racine Ave., Chicago 8, Ill.

DIVISION OF AMERICAN AIR FILTER COMPANY, INC.

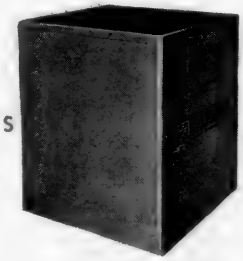
Heating Specialties · Power Specialties · Control Systems

QUALITY
has no substitute

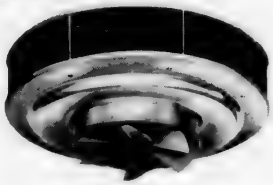
Use **KRITZER**
heating and cooling
equipment for profit
and top performance



DUAL-VECTOR®
Low cost, combination heating and cooling units for residences, apartments and motels. Two models fit between studding. Easy installation. Clean, filtered air both summer and winter. Insulated enclosures prevent condensation. Individual room control optional. Free-standing types for remodeling.

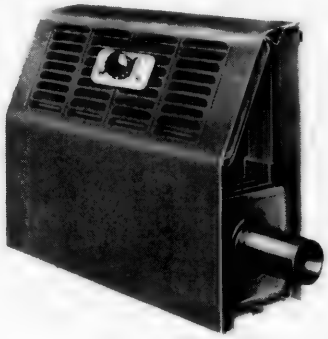


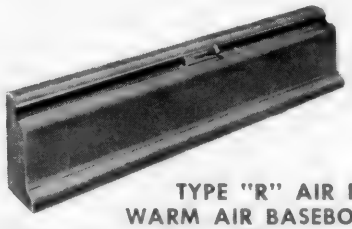
HYDRO-PAC® WATER CHILLERS
Completely packaged. Factory tested. Ready for easy field installation. Fine "furniture" steel cabinets with baked enamel finish. Five year warranty on hermetic system.



UNIT HEATERS Horizontal and vertical discharge, propeller fan types. Wide selection of sizes for steam and hot water. Die formed cabinets of heavy gauge steel. Baked-on, gray hammer enamel finish. Rubber mounted motors. Dynamically balanced fans in deep drawn venturi for quiet operation.

CONVECTOR-RADIATORS Floor, wall hung and recessed models. Famous KRITZER coil construction for steam and hot water. Bronze headers. Heavy, reinforced steel cabinets. Full range of sizes. Chain or knob operated dampers. Cabinets phosphatized. Gray prime, baked-on finish.





TYPE "R" AIR BASE WARM AIR BASEBOARD
Adds beauty to any home. Efficient warm air heating or cooling. Two and four foot lengths. Built to last.

"K" LINE RADIANT BASEBOARD
Clean, modern lines. Quiet. Easy to install. For homes, apartments, offices.

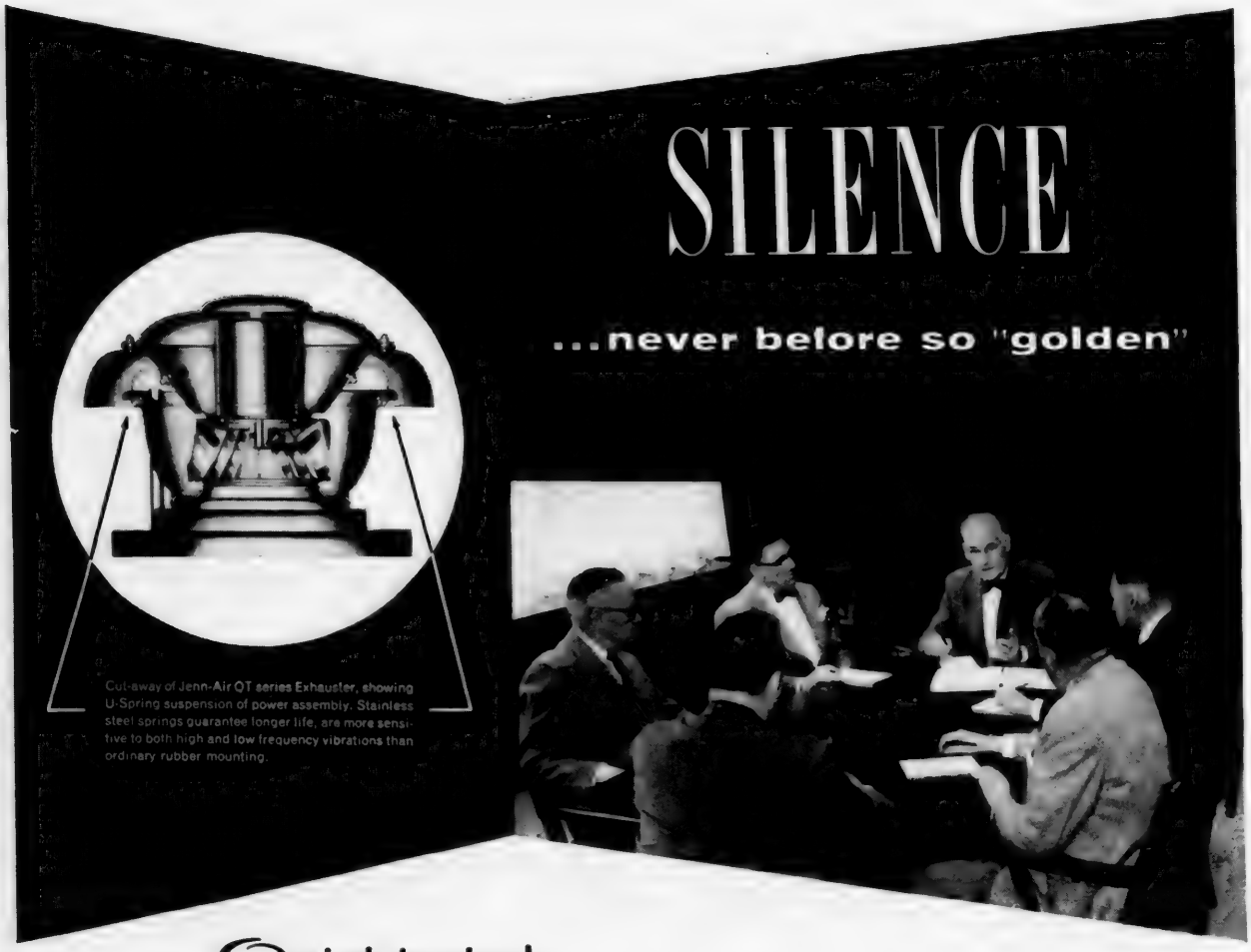
STB RADIANT BASEBOARD
For hard-to-heat areas. Large heating capacity. Safe, rounded corners and edges.

ASK YOUR JOBBER FOR KRITZER PRODUCTS

"IF IT'S KRITZER, IT'S RIGHT, SIR!"

KRITZER RADIANT COILS, INC.
2901 Lawrence Ave. • Chicago 25

KRITZER


SILENCE
...never before so "golden"
Cut-away of Jenn-Air QT series Exhauster, showing U-Spring suspension of power assembly. Stainless steel springs guarantee longer life, are more sensitive to both high and low frequency vibrations than ordinary rubber mounting.

Quiet-tested

JENN-AIR ROOF EXHAUSTER

with U-Spring Cushion Suspension Mounting . . . a boon to employee efficiency

Greater the disturbance—less the productive capacity of employees. Less the disturbance—greater their productive capacity. Now, Jenn-Air's exclusive Quiet-Tested Roof Exhauster virtually eliminates noise caused by vibration. U-Springs suspend the power assembly, isolate it from the base of the unit. Motor and blade are balanced together, as a further safeguard against vibration and noise.

While sharpening up personnel efficiency and worker output, the Jenn-Air Quiet-Tested Exhauster also stacks up dollars in day-by-day savings. Its all-aluminum construction assures better, longer, trouble-free performance. Maintenance costs are practically nil. Motors are lubricated for 10 years of continuous service. Striking, low contour beauty . . . years ahead of the field in neat, trim design.

Only Jenn-Air Quiet-Tested Roof Exhausters are pre-proven under simulated field conditions. Before leaving the factory, each unit must pass rigid inspection by the critical *Vibronic Eye* . . . is "screened" in Jenn-Air's Sound-Elec Test Chamber to detect noise and vibration.

Jenn-Air Exhausters are rated in accordance with the Standard Test Code by the Texas Engineering Experiment Station.

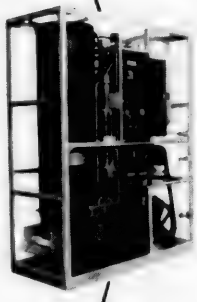
JENN-AIR PRODUCTS COMPANY, INC.

1102 Stadium Drive, Indianapolis 7, Indiana

ALLEN-BRADLEY

TROUBLE-FREE MOTOR CONTROLS

have been "standard" on Vogt Tube-Ice machines for over 18 years



Continuously dependable service . . . that is the reason Allen-Bradley motor controls are "standard" on so many refrigeration units . . . such as the Vogt Tube-Ice machine, shown here.

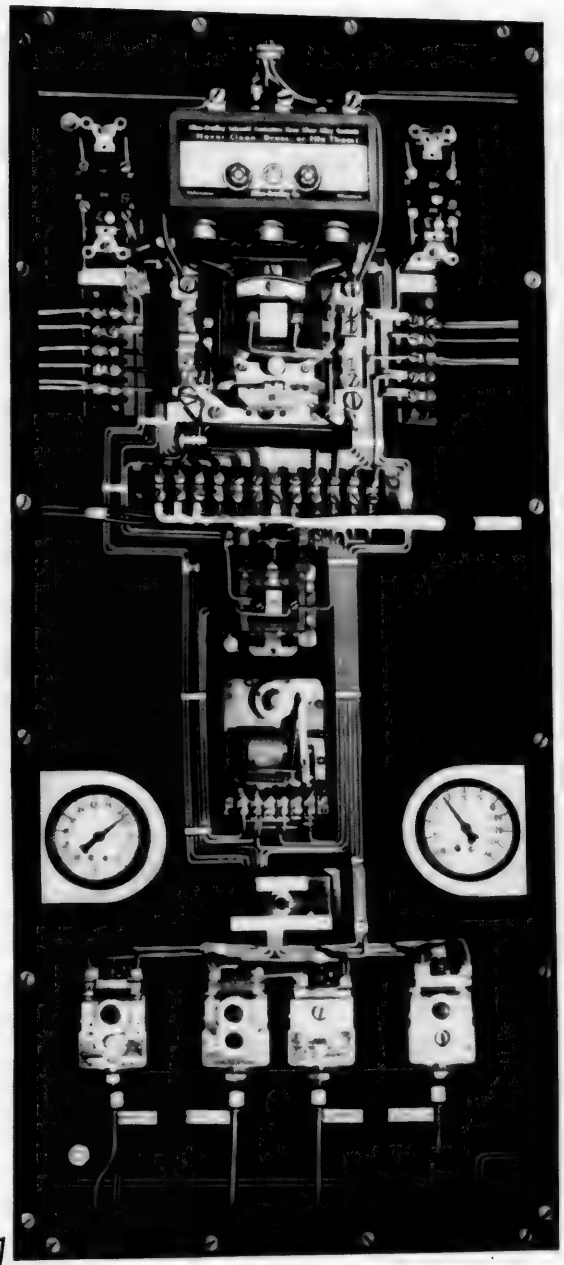
The simplicity of Allen-Bradley solenoid starters makes such performance possible . . . there is only ONE moving part . . . nothing to wear or bind . . . your guarantee for continuous, trouble-free operation. The double break, silver alloy contacts never need maintenance. You can install Allen-Bradley controls . . . and forget them.

Permanently accurate thermal overload relays protect motors against burnout. Specify Allen-Bradley . . . you'll never have reason to regret this decision.

Please write for your copy of the latest Allen-Bradley Handy Catalog . . . the guide to "Quality" motor control.

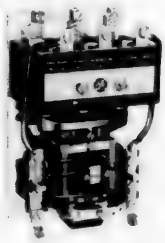
Allen-Bradley Co.
1330 S. Second St., Milwaukee 4, Wis.

In Canada
Allen-Bradley Canada Ltd., Galt, Ont.

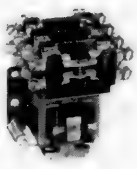


Above panel shows Allen-Bradley controls for 5,000 lb automatic Vogt Tube-Ice machine

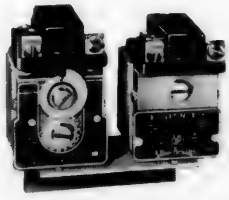
THE SIGN OF QUALITY
MOTOR CONTROL



BULLETIN 709
Across-the-line solenoid starter



BULLETIN 700
A-C control relay, universal type



BULLETIN 836
High and low-pressure cutouts

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY

THE SIZE, SHAPE AND QUALITY...

to fit your job best!

CHASE COPPER SOLDER-JOINT FITTINGS

Efficiency comes naturally to refrigeration and air conditioning systems made with Chase wrought copper solder-joint fittings! Flow of coolant is bound to be smooth and rapid. Flawless Chase fittings have no shoulders or rough interiors to cause turbulence or increase friction.

Couple Chase wrought fittings with Chase copper tube for *really outstanding* performance. They fit each other perfectly. Expand and contract as one rugged unit.

Use Chase wrought copper solder-joint fittings, clean-capped Chase Type L tube, and Chase extra-soft copper refrigeration tube. Your Chase wholesaler has a complete selection right on hand. Send him an order today!

Chase®

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

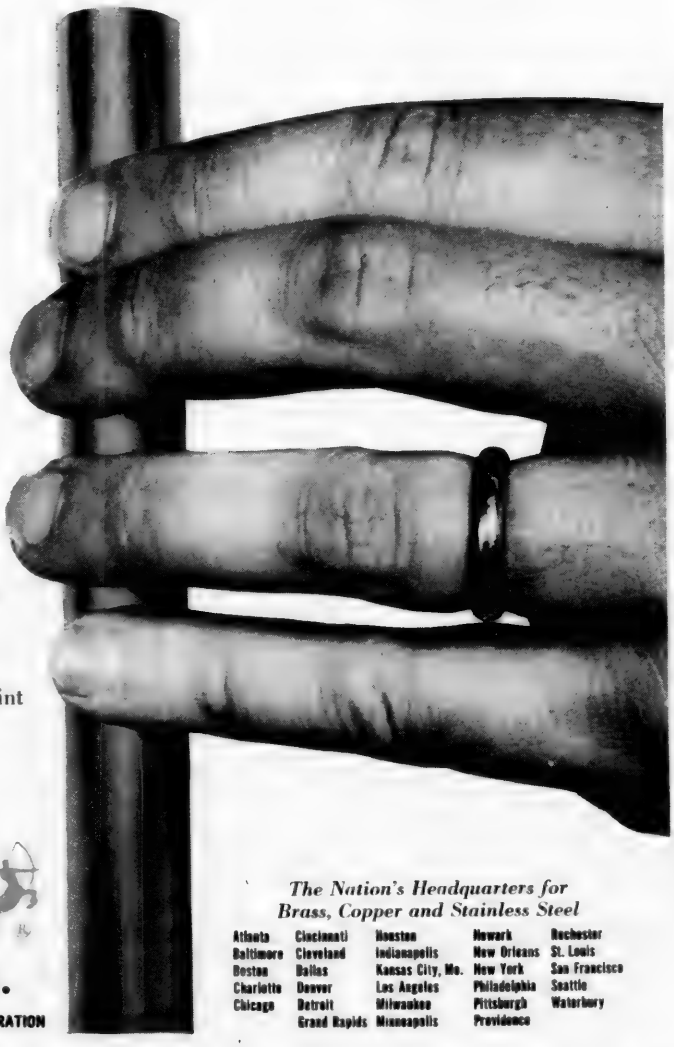
MADE *for each other...*

to do a better job for you!

CHASE® Type L Copper Tube and Wrought Solder-Joint Fittings

Accuracy is the keynote in Chase's manufacturing process for Type L copper tube and wrought solder-joint fittings for refrigeration and air conditioning. Inside and outside diameters are "right on the button." Metal of tube and fittings is identical. They fit each other perfectly—expand and contract *as one unit!* They're smoother, flawless! Straight lengths of tube can be obtained capped for cleanliness.

Your Chase wholesaler stocks coils and straight lengths of Type L copper tube in a wide range of sizes, and individually packaged coils of Chase extra-soft copper refrigeration tube. He also has Chase wrought solder-joint fittings in many styles and sizes. Order today!



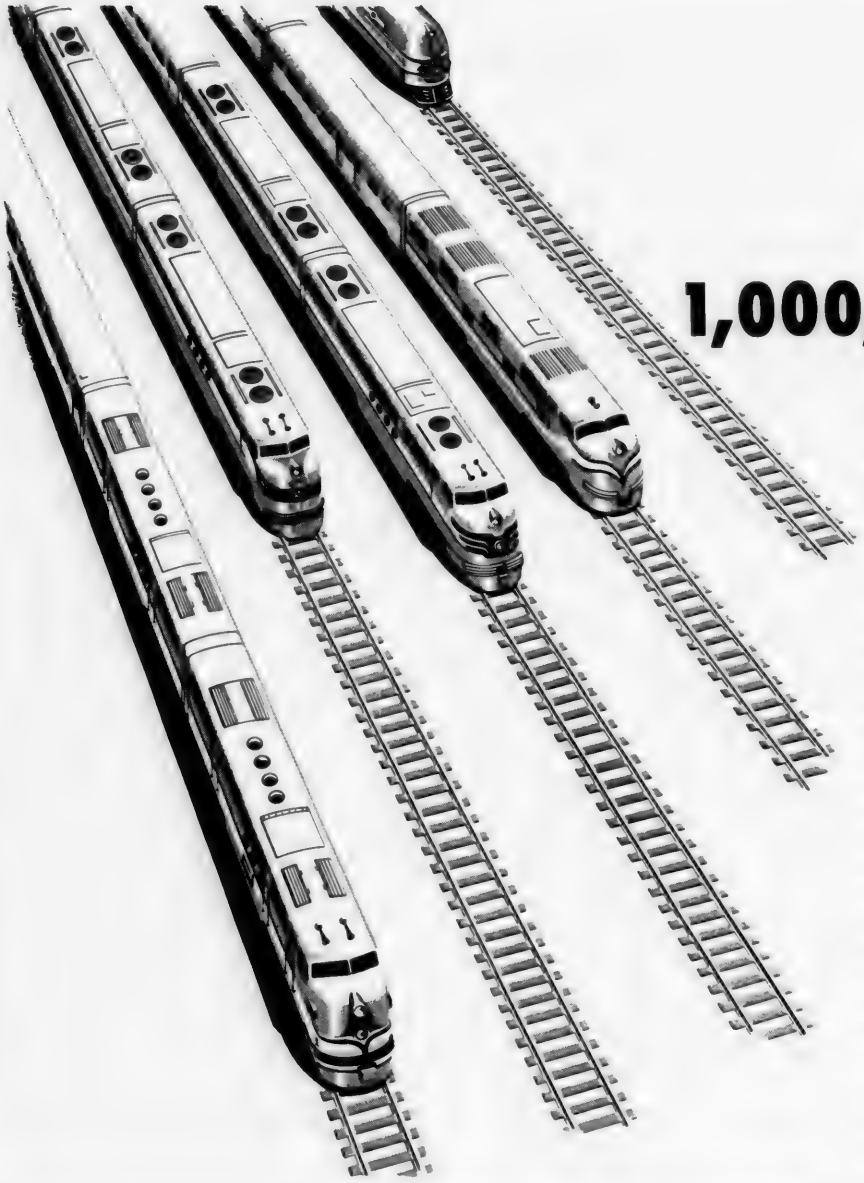
Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass, Copper and Stainless Steel

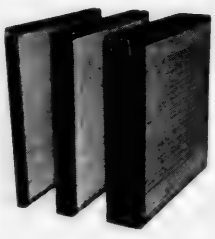
Atlanta	Cincinnati	Houston	Newark	Rochester
Baltimore	Cleveland	Indianapolis	New Orleans	St. Louis
Boston	Dallas	Kansas City, Mo.	New York	San Francisco
Charlotte	Denver	Los Angeles	Philadelphia	Seattle
Chicago	Detroit	Milwaukee	Pittsburgh	Waterbury
	Grand Rapids	Minneapolis	Providence	



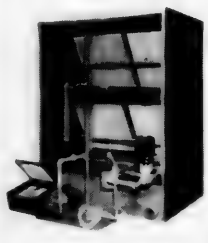
OVER 1,000,000,000 MILES OF TESTING

For many years, FAR-AIR® filters have been standard equipment on the country's leading railroads. They have earned this preference because of their proven ability to operate with uniformly high efficiency under every possible climatic condition. This toughest of all tests is watched critically by businessmen who not only demand top efficiency but economy as well. The fact that FAR-AIR filters have consistently come through with flying colors on both counts is your best assurance of satisfaction when this same equipment is used to solve your air filtration problems.

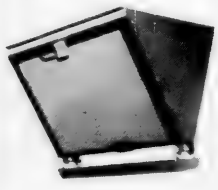
If you, too, look for reasonable first cost, low maintenance cost and high efficiency regardless of conditions, type of job or geographic location, you can depend on FAR-AIR. Write for complete catalog to FARR COMPANY, P. O. Box 45187, Airport Station, Los Angeles 45, California.



Heart of the FAR-AIR line is the 1", 2" and 4" thick filters. Available in all sizes and most metals.



Another FAR-AIR first. A completely automatic filter that washes and re-oils itself. Sizes to meet any CFM requirement.



A complete line of grease eliminators, easy to clean, safe to use, low in cost.

TYPICAL FAR-AIR PRODUCTS

ORIGINATORS OF FAR-AIR CERTIFIED FILTER SERVICE

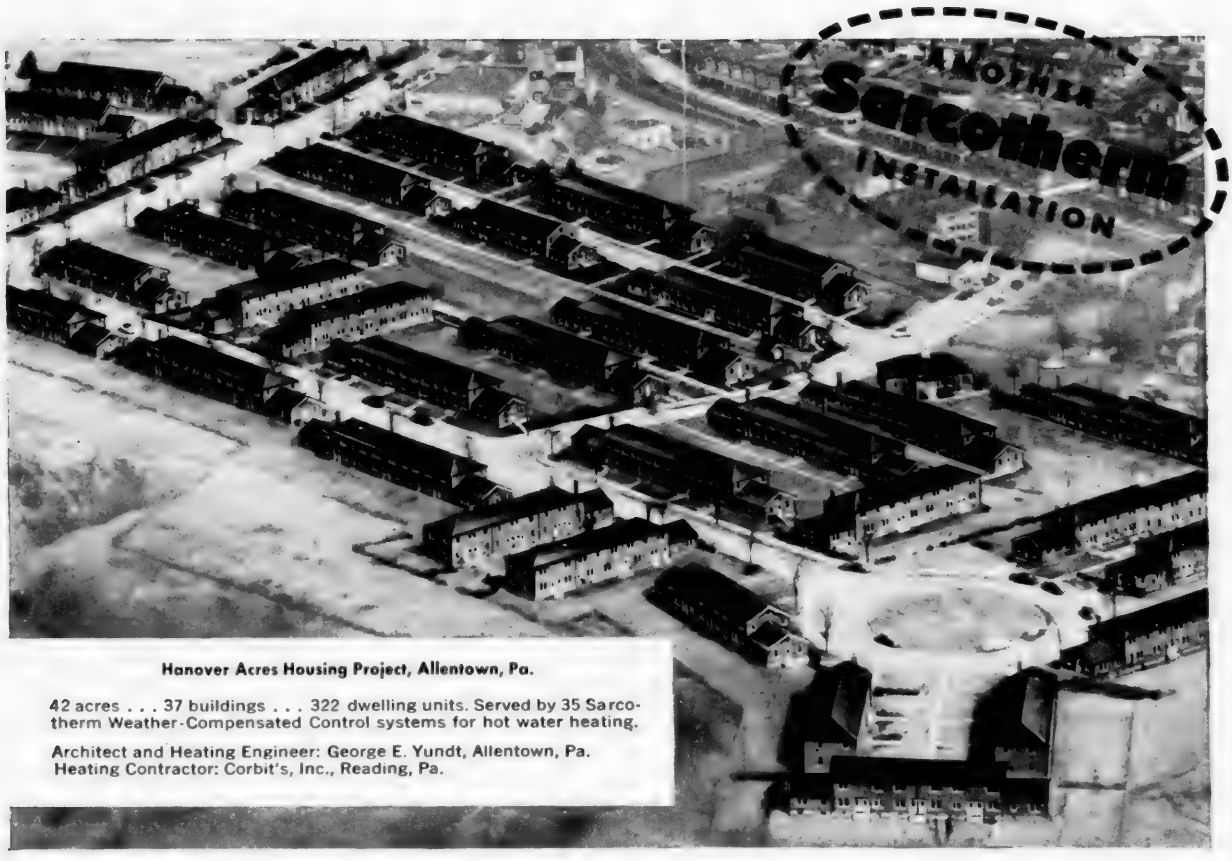
FARR COMPANY

NO COMPROMISE ON QUALITY

Los Angeles, New York, Chicago

New Orleans

MANUFACTURED UNDER LICENSE BY FARR COMPANY MANUFACTURING LTD MONTREAL CANADA



Hanover Acres Housing Project, Allentown, Pa.

42 acres . . . 37 buildings . . . 322 dwelling units. Served by 35 Sarcotherm Weather-Compensated Control systems for hot water heating.

Architect and Heating Engineer: George E. Yundt, Allentown, Pa.
Heating Contractor: Corbit's, Inc., Reading, Pa.

42 acres of comfortable heating ...for 16 years!

Provided by 35 Sarcotherm Weather-Compensated Control Systems

Here's the Test...35 Sarcotherm Systems...16 years on the job...serving 322 dwelling units at Hanover Acres Housing Project, Allentown, Pa. That's a tough test of heating control dependability and economy!

And here's the Result!...The Housing Authority of the City of Allentown reports...throughout the entire 16 years these Sarcotherm Weather-Compensated Control Systems for hot water heating have given trouble-free service and provided money-saving, comfortable heating.

Dependability-plus...that's one of the major reasons Sarcotherm Systems have been installed in many important projects including Hanover Acres and Beardsley Terrace Housing, Bridgeport, Connecticut.

For undivided responsibility on your installations, specify and order from one "Complete Line" source...SARCO-SARCOTHERM.

Write for catalogs. Sarcotherm Controls, Inc., Empire State Building, New York 1, N. Y.

ADVANTAGES OF SARCOTHERM SYSTEMS

On-the-job help—Sarcotherm engineers cooperate in preparing working drawings and wiring diagrams for each job. Also assist in supervising the installation.

Easy to maintain—simple, trouble-free design, fewer parts.

Easy to adjust—to any desired setting.

Complete Control Systems from Sarcotherm include all accessories such as control panels, thermostats, radiator valves, balancing fittings, steam traps, domestic hot water controls, etc.

4008-B

Sarcotherm

AN AFFILIATE OF SARCO CO., INC.

Weather-Compensated control systems for steam, hot water and radiant heating

The eight-story building is constructed on a framework of steel and reinforced concrete. The base is black St. Cloud granite, with the upper stories of cream-colored Minnesota Kasota stone.

Architect—Ellerbe and Company, St. Paul, Minn.
Contractor—The Baumeister Construction Company, St. Paul, Minn.
Heating Contractor—Hankee Heating Company, St. Paul, Minn.

BEAUTIFULLY EFFICIENT... EFFICIENTLY BEAUTIFUL...

Minnesota Mutual Life Insurance Company's gleaming new Home Office Building is the result of the combined efforts of the company's planners, the architects and the builders to couple modern beauty with top efficiency. It is said the now-completed structure is the most efficient physical plant that could be designed for the complex operations of this growing organization.

A significant phase in the effort to obtain the utmost in efficiency and dependability was the installation of USS NATIONAL Steel Pipe for the hot water heating and snow melting systems of the handsome new structure. Over 7000 feet of ¾-inch NATIONAL Pipe were used in the snow melting system, alone.

The consistent selection of NATIONAL Steel Pipe for the "big jobs" is nothing new. For over 60 years NATIONAL has been the accepted pipe for plumbing and heating systems. Regardless of the application, architects, builders and contractors know from long experience that they can put their complete confidence in the uniform, dependable performance of NATIONAL Pipe. Plan on using America's Standard Wrought Pipe in your next installation.

The snow melting system being installed. All ¾-inch lines and 2-inch headers were of NATIONAL Steel Pipe.

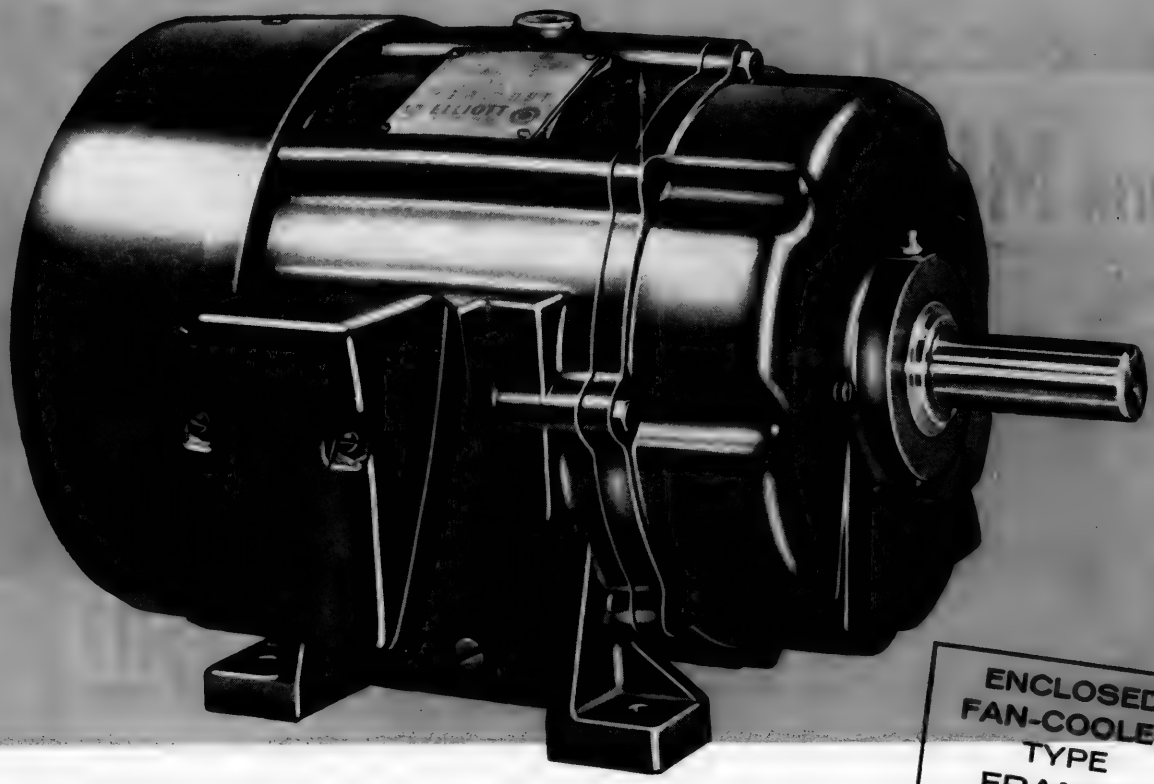
NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

NATIONAL PIPE

UNITED STATES STEEL

Inside and Outside . . . entirely new



ENCLOSED
FAN-COOLED
TYPE
FRAMES
184-256U

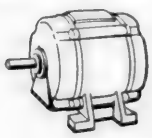
Elliott C-W Type N Motors

NEW PERFORMANCE! You get more horsepower per pound from these compact Elliott C-W motors because of their improved design, and the use of vastly superior insulating materials and electrical steels. Due to greater mechanical and dielectric strength, insulating materials occupy less space. More space is available for copper—the "muscle" of the motor.

NEW PROTECTION! Internal parts of Elliott C-W motors are completely protected by rugged housings—dripproof, or totally-enclosed, as required. Efficient fans assure ample cooling.

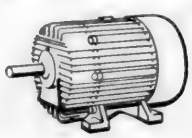
NEW DEPENDABILITY! New Elliott C-W type N motors are designed for the utmost in dependability. They will withstand physical abuse. Use of highly dependable insulating materials assures prolonged life; anti-friction bearings are available in several optional types, to meet severe service conditions.

OTHER C-W TYPE N MOTOR ENCLOSURES



Totally-enclosed non-ventilated

Dripproof Protected



Totally-enclosed, fan-cooled (ribbed frame)

ELLIOTT Company

CROCKER-WHEELER DIVISION

WRITE for new bulletin describing Elliott C-W Type N Motors. Address: Elliott Company, Crocker-Wheeler Division, Jeannette, Pa.

W6-4

KRAMER

AIR CONDITIONING UNITS with MUGGY-AIR CONTROL

give comfort when others fail!

Another new Kramer achievement. Muggy-Air-Control takes the "chill and dampness" out of cooling on "muggy days" without reheat or dampers.

With two independent refrigerant circuits the upper circuit can be cut out on high humidity days. This sharply increases the dehumidifying effect by lowering the coil refrigerant temperature. Air is by-passed through the non-operating circuit and will mix with the dehumidified air to give desirable discharge temperatures and thus overcome short-cycling and uncomfortable conditions on muggy days.

Other distinct features of the Kramer Air Conditioning Unit are: the "Blow-Through" design, the Anti-Sweat construction, the "floating power" mounting, the nearly silent operation, and the eye appealing design.

WRITE FOR BULLETIN NO. AC-238

KRAMER TRENTON CO. • Trenton 5, N.J.

For lowest cost steam generation, *General Electric,* Louisville, Ky., burns coal the modern way.

At *American Cyanamid,* Bridgeville, Pennsylvania, power system modernization saves the firm $100,000 a year.

Burning coal the modern way at *Pennsylvania RR's* Juniata shops in Altoona saves $500,000 a year.

Each year more firms

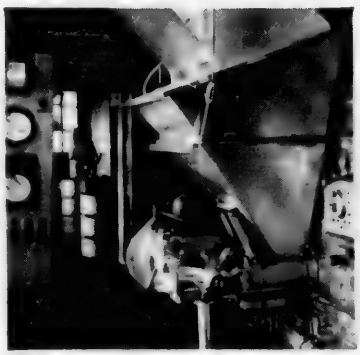
Carbide & Carbon, South Charleston, W. Va., saves $470,000 a year in lower costs and increased efficiency.

Coal costs 40% less than the next cheapest fuel at *Pinehurst, N. C.* resort . . . modernized plant 33% more efficient.

Modernization at *John Strange Paper Co.,* Menasha, Wis., reduced power costs and increased plant production 10%.

are burning coal the modern way

Modernization by *Clark Equipment Co.,* Battle Creek, Mich., supplies power for expanding production facilities, saves $7,500 annually.



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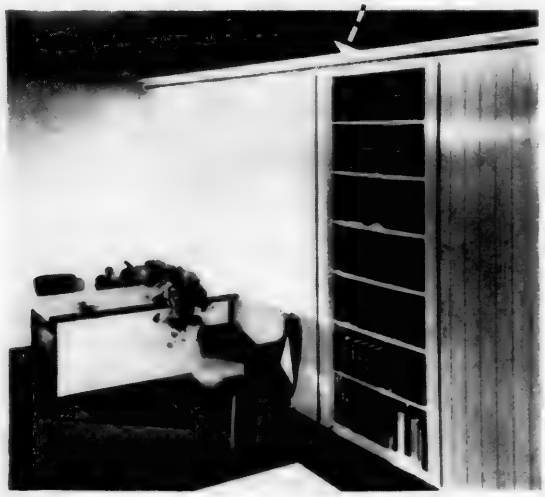

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78 JENKINS PRACTICAL PIPING LAYOUTS

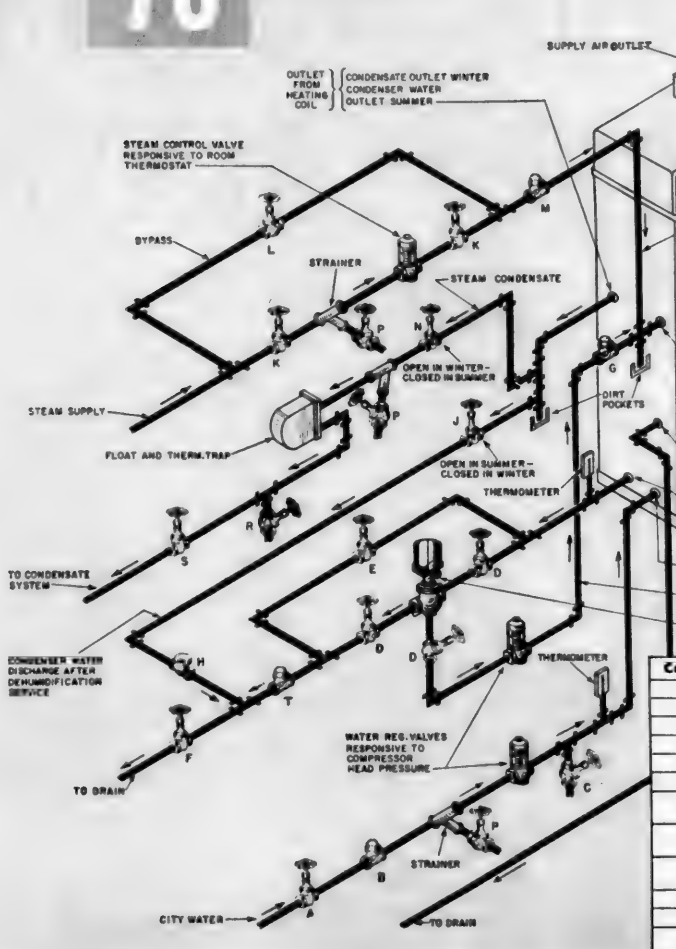

Diagram by Huxley Madeheim
Consulting Engineer
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VALVE RECOMMENDATIONS
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Code	Qty.	Jenkins Valve	Service
A	1	Fig. 370 Br. Gate	City Water Shutoff
B	1	Fig. 92-A Br. Sw. Check	Prevent Contam. City Water
C	1	Fig. 106-A Br. Globe	Drain Water System
D	3	Fig. 370 Br. Gate	Shutoff Control Valve
E	1	Fig. 370 Br. Gate	Bypass Control Valve
F	1	Fig. 370 Br. Gate	Shutoff Drain Line
G	1	Fig. 92-A Br. Sw. Check	Prevent Stm. Flow To Water Line
H	1	Fig. 117-A Br. Lift Check	Prevent Backflow Thru Htg. Coil
J	1	Fig. 47-U Br. Gate	Prevent Stm. Flow To Drain
K	2	Fig. 370 Br. Gate	Shutoff Control Valve
L	1	Fig. 106-A Br. Globe	Bypass Control Valve
M	1	Fig. 92-A Br. Sw. Check	Prevent Water Flow To Stm. Line
N	1	Fig. 47-U Br. Gate	Shutoff Water To Cond. Syst.
P	4	Fig. 106-A Br. Globe	Strainer Blowoff
R	1	Fig. 106-A Br. Globe	Trap Test
S	1	Fig. 370 Br. Gate	Shutoff Condensate Flow

How to plan piping connections for an all-year SELF-CONTAINED AIR CONDITIONING UNIT

A factory-built "package", the self-contained air conditioning unit shown in this layout is designed for both summer cooling and winter heating. In this particular system, it is assumed that steam is available for winter heating, and that the condenser is served by the city water supply. The condenser water discharge is used for the reheat necessary for humidity control.

The hookup for humidity control, particularly important for installations such as in night clubs, auditoriums, and others having a high moisture removal load, is shown in the diagram.

During the winter season, the heat output is regulated by a modulating steam valve which operates in response to a room thermostat. In the summer, another room thermostat starts the compressor when cooling is required, and the two-position water control valve, located as shown in the diagram, permits the water to flow to the drain.

When dehumidification is required without cooling, a room humidistat keeps the compressor in operation, but changes the position of the two-position water control valve so that the condenser discharge flows to the heating coil.

Two water-regulating valves are employed as illustrated. One, in the city water line, is set in the usual manner to maintain a predetermined head pressure on the compressor by varying the amount of water flowing into the condenser. The second, in the line from the condenser to the heating coil, is set for a head pressure higher than the pressure on the feed control valve.

This secondary condenser water control reduces cooling capacity and, at the same time, provides hotter water for reheat in the heating coil, thus serving to maintain proper relative humidity without excessive reduction of temperature. The amount of reheat obtained is approximately equal to the cooling provided by the unit, so that the net effect is that of dehumidification only, without cooling.

Consultation with accredited piping engineers and contractors is recommended when planning any piping system.

Enlarged diagram and full description of this layout free on request. Ask for Layout No. 78. Jenkins Bros., 100 Park Ave., New York 17.

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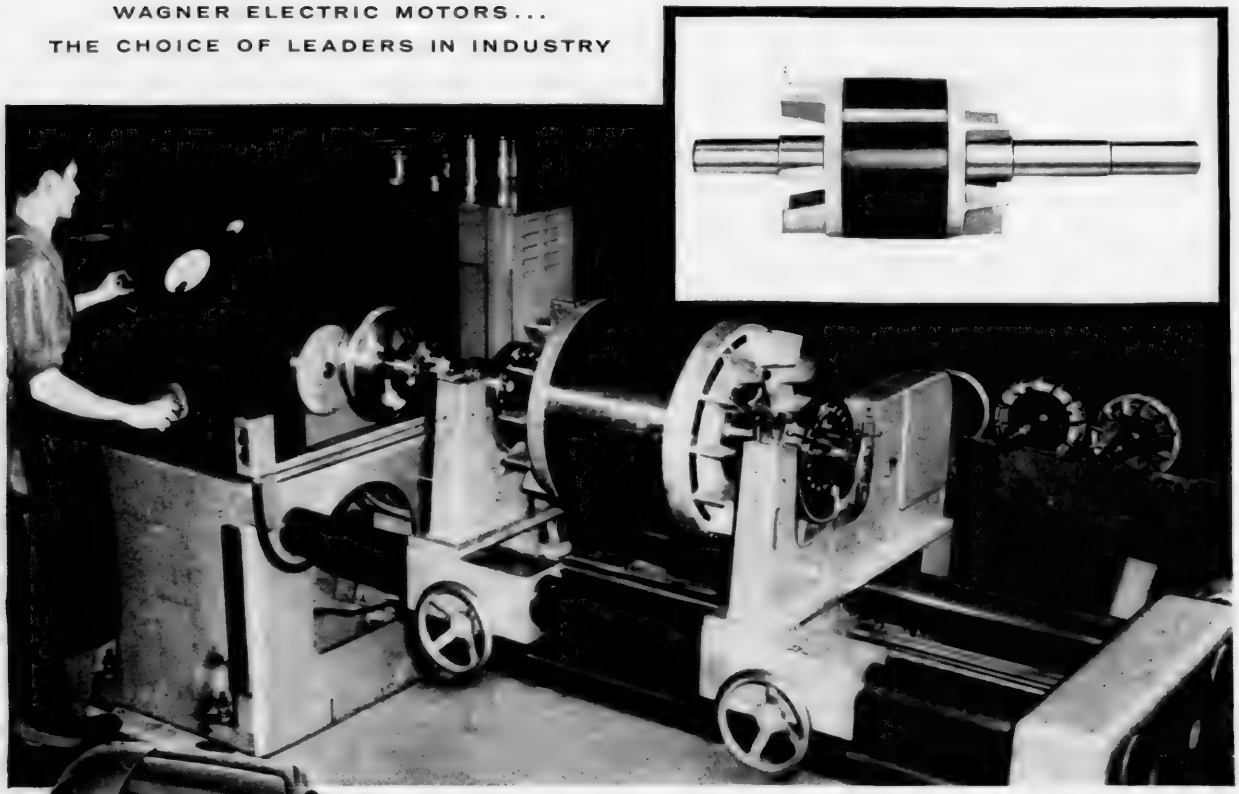
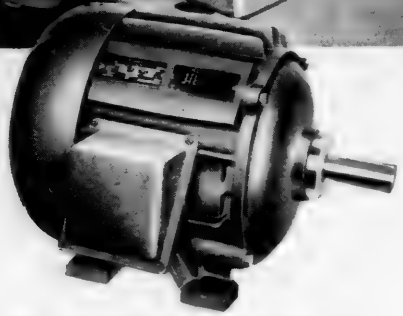
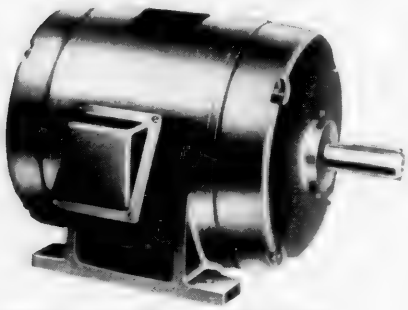




Wagner totally-enclosed fan-cooled motor.
1 through 30 hp, NEMA Frames 182-326U.



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Howard F. Burrell, Chief Engineer, reports that Pittsburgh Glasfloss Filters are easy to handle, soft and light weight; and that this Fiber Glass filter does not splinter or shred.

"We effected a direct unit saving of 13% by switching to Pittsburgh Glasfloss Air Filters"

—says Howard F. Burrell, Chief Engineer
JOSEPH HORNE CO., Pittsburgh, Pa.

"The filters we previously used in our store-wide air conditioning system would shred and stick to fingers and clothing when handled," reports Mr. Burrell. "They were not uniform in quality and their performance was erratic.

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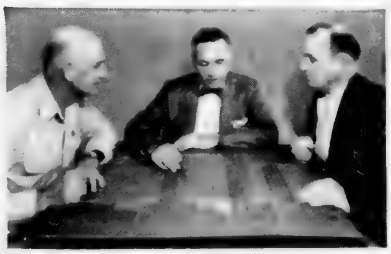

Building Supt. C. W. McCormick, American Blower's I. A. Lindberg, and Building Mgr. E. E. McClung worked together during installation of equipment.

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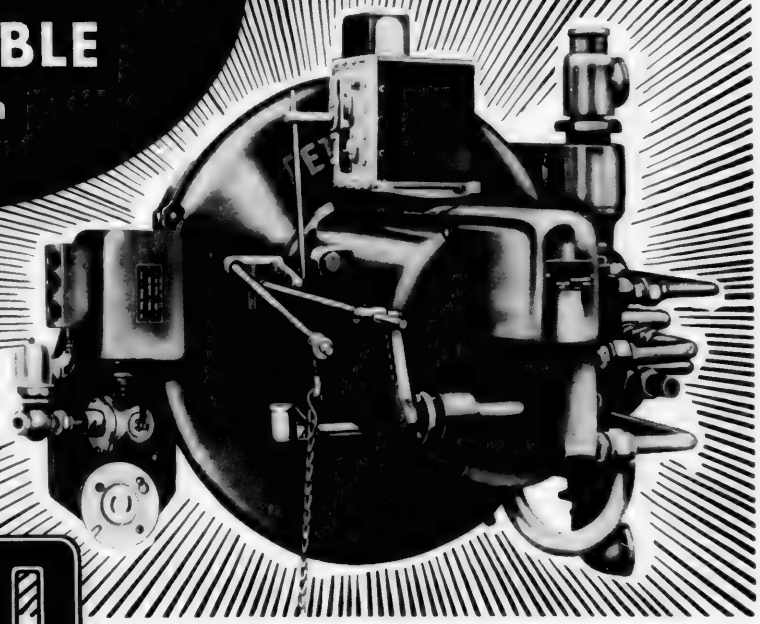

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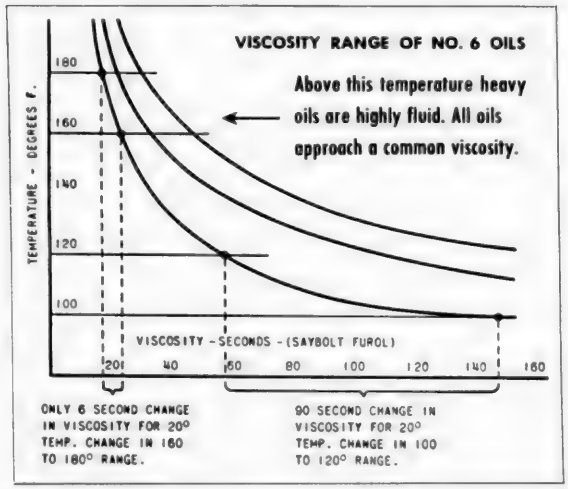

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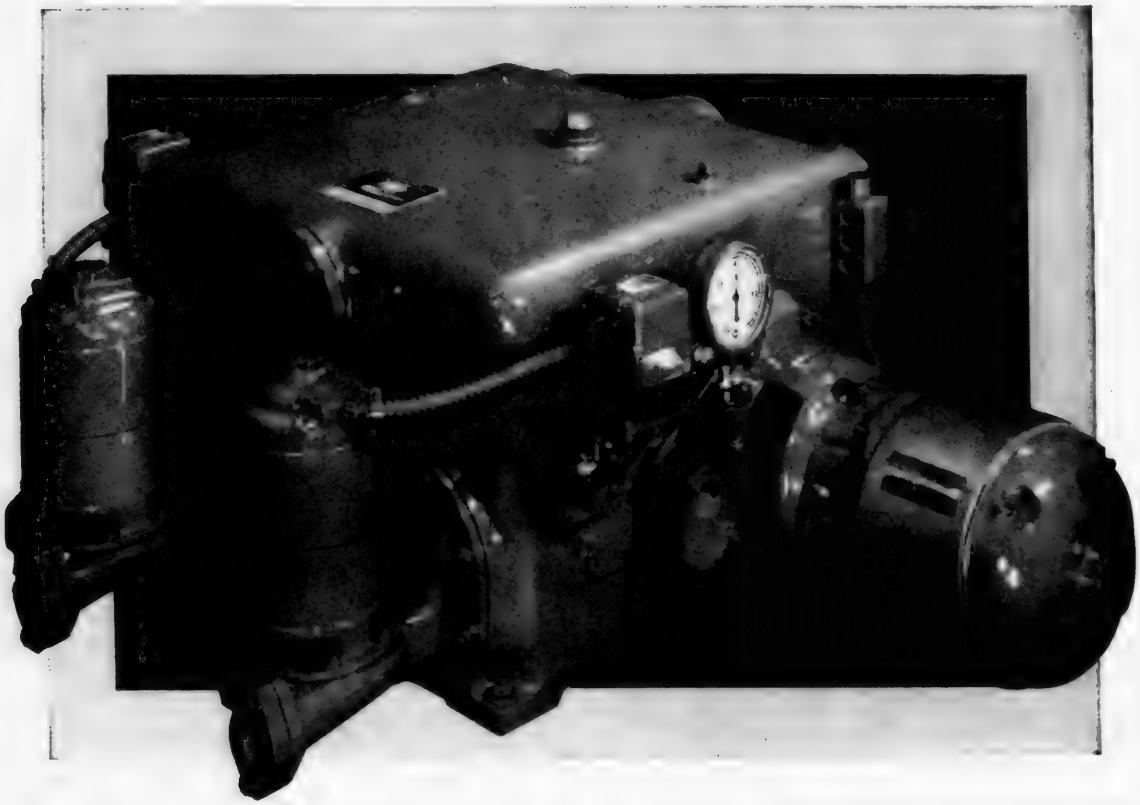

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- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
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- Low, low, return line connection.

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Calculating the Heat Requirements of a Snow Melting System

WILLIAM P. CHAPMAN

In this article, the first of a series, the author presents data resulting from an elaborate project in which a vast array of U. S. Weather Bureau data were analyzed by punched card technics. In this project, the pertinent combinations of four climatic variables affecting snow melting systems were reduced, city by city, to frequency distributions, from which all necessary design and operating data were derived. This article covers Detroit, Columbus and Pittsburgh; subsequent articles will be devoted to other areas.

THE HEAT required by a snow melting system depends on four climatic variables each of which varies from city to city. While formulas have been developed for calculating these energy requirements, the values and frequency of the climatic variables have not up to now been available for more than a few localities in the United States. It is the object of this series of articles to present tabular information on climatic data relating to the subject for a number of scattered U. S. cities and from which the total heat requirements per square foot of snow melting area are to be determined. These data will include maximum heat output as well as information on how often the system will operate, how often it must operate at a given heat output, and the most probable heat output.

The four climatic variables entering into the calculation of a snow melting system are (1) velocity of wind, (2) air temperature, (3) relative humidity of the air, and (4) amount of snowfall. Each of these must be properly weighed; a change in one may offset a change in another. For example, a 5 mph decrease in wind velocity can *reduce* the heat load more than a 10 degree decrease in air temperature or a one-half inch per hour increase in snowfall would *increase* the load.

The total heat output of a snow melting slab consists of the heat required to (1) raise the temperature of the snow to the melting point, (2) melt the snow (heat of fusion), (3) evaporate a portion of the melted snow and (4) make up the heat transferred by convection and radiation from that portion of the slab free of snow.

The total heat requirements of a snow melting slab can be expressed in the basic equation:

$$q_t = q_s + q_m + A_r (9_c + 9_h)$$

where q_t = total heat, Btu per (hour) (sq ft).

q_s = sensible heat, Btu per (hour) (sq ft).

q_m = heat to melt the snow, Btu per (hour) (sq ft).

q_e = heat to evaporate the melted snow, Btu per (hour) (sq ft).

q_h = heat transferred by radiation and convection, Btu per (hour) (sq ft).

A_r = free area ratio.

The derivation of the four equations for computing q_s, q_m, q_e, and q_h have been given previously and need not be repeated here.* Air temperature, rate of snowfall, wind velocity and vapor pressure of the air all enter into their calculation, and all of these are climatic variables.

In the foregoing equation, note that the last two items making up the equation, q_e and q_h, have no value while the slab is entirely covered by snow, since the melted snow beneath cannot evaporate nor can the slab lose heat by radiation and convection. When the slab is partially freed of snow, q_e and q_h have a value depending on the ratio of free area (melted area) to the total slab area. This ratio is termed free air ratio, and is expressed algebraically by

$$A_r = A_f/A_t$$

where A_r = free air ratio, A_f = area of slab free of snow, in sq ft, A_t = total area of slab.

It may be shown that there are just three practical values for A_r, namely, zero, 0.5 and 1.0. When the free area ratio, A_r, is equal to zero, the slab is covered completely with snow. Although this condition can be defined as a failure of the system it may be tolerable in some instances for short periods of time. When the free area ratio, A_r, is equal to unity, the slab is completely free of snow. This situation requires the maximum output for a given weather condition.

An intermediate value of $A_r = 0.5$ indicates a partial coverage of snow. A very light coverage of snow will develop a free area ratio of 0.5, but probably will not reduce traction dangerously.

The total heat output of a snow melting system depends on the rate at which it melts the snow, and this rate in turn depends on the relative importance of rapid snow removal among the different types of applications. Snow melting systems can be classified as follows:

Class I (minimum): Residential walks or driveways and interplant areaways;

Class II (moderate): Commercial (stores and offices) sidewalks and driveways and steps of hospitals; and

Class III (maximum): Toll plazas of highways and bridges, and aprons and loading areas of airports.

These classifications depend upon the allowable rate of snow melting. For example, a residential system does not have to melt snow as rapidly as a commercial system. In fact, a depth of snow of an inch for an hour or so during a heavy storm might not be objectionable with a residential system. On the other hand, a store manager would claim the system was inadequate if half an inch accumulated on the sidewalk in front of his store. The difference, then, between a Class I system and a Class II system is in the ability of each system to melt snow. The one feature that is common to all classes is that the systems must be adequate for some combination of weather factors. Or, the designer wants to be able to say that he will pay to melt snow whenever conditions are milder than some critical value, but he is willing to have an inadequate system for a given fraction of the time. In other words, the designer will run a calculated risk providing he knows the odds of that risk. For a residential system, where initial cost must be at a minimum, the designer must accept more frequent snow accumulations.

Naturally, the owner is not concerned about an explanation of why there is an accumulation of snow on the sidewalk. It is immaterial whether the accumulation is due to an excessive snowfall or whether it is due to an extremely cold snowfall. In both cases, the ultimate reason is that an inadequate flow of heat is reaching the surface. The true analysis of heat output, then, depends on an analysis of the weather. This is true of all three system classes.

The total heat requirements of a snow melting system are determined, therefore, by (a) the total area of the snow melting slab, (b) the rate at which the snow is to be removed, and (c) the values and frequency distribution of each of the pertinent climatic variables (humidity, wind, temperature, and snowfall). Obviously (c) varies from city to city and, due to the complexity and number of calculations to obtain a frequency distribution of the four variables, the evaluation of (c) has been virtually impossible. However, by the use of punched cards and statistical tabulating machines, data have been derived so that the heat requirements for a given city can be simply presented.

The designer needs two types of information. First, the most severe combinations of variables on which to base his *design output*, and, second, the heat required over the season so that *operating costs* can be determined. These data are given in Tables 1, 2, 3, and 4 which follow and which cover three cities in the North Mideast region of the U. S.

Table 1

The first table gives some generalized information on snowfall and snow on the ground. The next to last item, "Greatest depth of snow on the ground" indicates the greatest depth to which snowfall has ever accumulated. Other items are self-explanatory.

TABLE 1—GENERAL INFORMATION ON SNOWFALL, NORTH MIDEAST REGION

Item	Detroit, Mich.	Columbus, Ohio	Pittsburgh, Pa.
Approximate mean number of days with an inch or more of snow on the ground	85	50	70
Average number of inches of snowfall per year	39.8	21.7	34.7
Greatest snowfall in 24 hours, inches	24.5	11.9	17.5
Greatest depth of snow on the ground, inches	26	13.5	23
Mean number of days per year with snowfall of 1 inch or more	13	6	11

*Design of Snow Melting Systems, Heating and Ventilating, April, 1952, and Design Conditions for Snow Melting, November, 1952, by William P. Chapman.

TABLE 2—DATA FOR DETERMINING OPERATING CHARACTERISTICS OF SNOW MELTING SYSTEM, NORTH MIDEAST REGION[1]

City	Period of No Snowfall				Period of Snowfall[3]								
	Air Temperature, Deg. F.[2]				Hours of Snowfall[2]			Required Output, Btu per Sq. Ft.[4]					
	Over 32	Below or Equal to 32	Mean Temp., During Freezing Period[6]	Wind Velocity, Freezing Period, mph[6]			Free Air Ratio, A_r	0-49	50-99	100-149	150-199	200-249	250-299	Maximum Output, Btu per Sq. Ft.
	Per-cent of Winter Hours with No Snow at Above Temp.				Per-Cent	Hr. per Year		Frequency Distribution of Snowfall Hours at Above Outputs, Per-Cent[5]						
Detroit, Mich.	47.0	49.3	24.1	10.6	3.7	134	1	60.4	27.7	9.3	1.5	0.8	0.3	278
							0	95.9	3.5	0.6	—	—	—	140
Columbus, Ohio	59.0	38.1	24.5	10.0	2.9	105	1	65.8	22.4	8.0	1.7	1.7	0.4	261
							0	97.7	2.3	—	—	—	—	72
Pittsburgh, Pa.	55.2	39.8	24.3	11.6	5.0	182	1	53.6	30.8	8.4	4.6	1.9	0.7	282
							0	93.3	5.9	0.7	0.1	—	—	157

[1]The period covered by this table is from Nov. 1 to March 31, incl., with February taken as a 28¼ day month. Total hours in period = 3630.
[2]The percentage in Columns 2 and 3 plus the percent under operating time total 100%. Note that "Hours of Snowfall" does not include idling time, and is not actual operating time. See text.
[3]Snowfalls of trace amounts are not included; hence, "Hours of Snowfall" includes only those hours of 0.01 inches water equivalent per hour snowfall.
[4]Output does not include allowance for back or edge losses since these depend on slab construction.
[5]Percentages total 100% of the number of hours per year of snowfall.
[6]"Freezing Period" is that during No Snowfall when the air temperature is 32 deg or below.

Table 2

Table 2 contains the operating information of a snow melting system. For freezing temperatures (32 deg and below) but no snowfall the system may be "idling." That is, the designer may want to supply some heat to the slab so that there will be immediate melting when snow starts to fall. The column on mean temperature gives the average temperature during *freezing* temperatures. This temperature is used in calculating the "idling" load. The other term needed to calculate idling load is the wind velocity during the period of freezing temperatures.

The column "Hours of Snowfall" indicates the number of hours that snow is falling at rates equal to or greater than 0.01 inch of water equivalent per hour. Roughly speaking there are snowfalls of "trace" quantities about twice as often as there are for measurable quantities of 0.01 inch or more. It is assumed that these light falls can be handled by the idling load.

The remaining columns of Table 2 represent the frequency distribution of required heat output. This distribution is based on the solution to the basic equation for two values of the free air ratio A_r. This distribution represents the heart of the analysis and is also the basis for Tables 3 and 4.

Table 3

Table 3 contains the *design* heat requirement—as explained in the footnotes to Table 3. These design rates may be altered by the designer if he feels that a particular job should have a different design criterion from those given in the footnote. Any change in design selection should be based on the frequency distribution given in Table 2.

Table 4

Table 4 contains the data required to estimate the operating cost of a snow melting system. The footnotes to Table 4 explain the various items.

Use of the Tables

An engineer has been asked to write a report on the feasibility of a snow melting system for a bridge approach in Pittsburgh, to have an area of 50,000 sq ft.

The need for snowmelting is shown very clearly in Table 1. Of the 151 days of winter—from November 1 to April 1—nearly half will have a snow cover of at least one inch. This snow cover results from an average of 182 hours (see Table 2) of snowfall totalling 34.7 inches of snow per year. An average of 11 days per year have snowfalls of an inch or more. The most severe fall was 17.5 inches in 24 hours which resulted in a record depth of 23 inches of snow on the ground.

Normally about one-third of the operating time of a snow melting system occurs during measurable falls; i.e., the operating time of 182 hours per year as shown in Table 2 would represent about one-third of the actual operating time. This is due to two factors. First, snowfalls of "trace" quantities are not listed as "hours of snowfall." Second, systems are not shut off when the last snowflake has fallen. One can expect, therefore, that a system in Pittsburgh will be in operation about 550 hours per year.

Since this system is for a bridge ramp, it would be classified as a Class III system. The reason for this is that, from Table 3, we find that the design rate is 275 Btu per (hour) (sq ft) for a Class III system, whereas a Class II system would have a design rate of 157 Btu per (hour) (sq ft). Notice that rule 3, in the footnote for Table 3, indicates that 157 Btu per (hour) (sq ft) might not provide a free area ratio of 0.5 under certain conditions. For highway areas the coefficient of friction for rubber tires on new concrete is taken as 0.9 when the concrete is wet and 0.2 for packed snow. Safe driving requires a minimum coefficient of 0.4; therefore, a free area ratio of 0.5 is considered a minimum for good traction. Just as important, as rule 3, however, are rules 1 and 4; therefore, for a bridge ramp a Class III system should be used.

The operating data shown for a Class III system in

TABLE 3—DESIGN DATA FOR SNOW MELTING SYSTEMS, NORTH MIDEAST REGION

City	Design Output, Btu per (Hour) (Sq Ft)		
	Class I System[1]	Class II System[2]	Class III System[3]
Detroit, Mich.	69	140	255
Columbus, Ohio	52	72	253
Pittsburgh, Pa.	89	157	275

[1]For Class I (residential) Systems, the design output is set at that required heat output (see Table 2) when $A_F = 0$ at the 98th percentile of the frequency distribution; that is, where 98% of the hours have this output or less.

[2]For Class II (commercial) System, the design output is the maximum output when $A_F = 0$ in Table 2 (last column).

[3]For Class III (industrial) Systems, the design output is determined by the following four requirements: (1) Output is never exceeded for two consecutive hours; (2) Output for $A_F = 1$; Table 2, is at least 1 Btu per hour per sq ft greater than maximum output for $A_F = 0$; (3) A_F is greater than or equal to 0.5 the maximum requirement shown in Table 2 for $A_F = 1$. That is, $q_d = q_a + q_m + 0.5\ (q_e + q_b)$ for the conditions where $q_t = q_a + q_m + q_e + q_e$ are a maximum; (4) The free air ratio A_F is unity for at least 98% of the hours listed in Table 2.

Table 4 are based on the data given in Table 2. The output is given in terms of Btu so that different fuel costs may be considered readily. For this case, the idling period should be taken as 360 (twice 182), so that the idling load would be 360 × 49.5 or about 18,000 Btu per (year) (sq ft). The heat for melting is given as 11,100 Btu per (year) (sq ft) so that the total operating load could be estimated as 18,000 + 11,100 or approximately 30,000 Btu per (year) (sq ft). The area is 50,000 sq ft, hence, the load would be 1.5 billion Btu per (year) (sq ft). For costs of 65 cents per million Btu, the fuel cost would be $975 per year, with no allowance for back or edge losses.

The North Mideast Region

This region includes Michigan south of Mackinac, Ohio, West Virginia and that part of Pennsylvania east of the Allegheny Mountain range. This region is flat except for the eastern edge and climatically milder than the regions to the north and west. The three cities used for typical analyses are Detroit, Columbus, and Pittsburgh. The climates of the three cities are fairly similar.

The predominant source of winter conditions has a polar source in Canada and moves in directly from the north or from the west. There are, however, frequent invasions of air from the Gulf of Mexico, especially at the beginning or end of the snow season.

The normal growing season, from the last killing frost in the spring to the first in the fall, is about 180 days. In all three cities the snow season starts in November and ends in March with January receiving the greatest fall. Typical of the Ohio Valley climate, however, the winters vary greatly in severity. In Columbus, for example, the average length of sub-zero periods is less than two days—with half of them as single occurrences—but in February, 1899, there were seven consecutive nights with sub-zero temperatures. On the other hand, one winter out of three will go by without a single reading below zero.

The winter weather is marked by considerable cloudiness. As a result, relative humidity is rather high. For example, in Detroit humidity ranges from 63 to 82% during the five months of November to March. Since the weather is temperate, considerable rainfall occurs during the winter months, but during December, January and February, there is a substantial amount of snow averaging approximately 30 inches per year.

The snowfall in almost all of this area is moderate. As shown in Tables 2 and 3, the requirements throughout the entire region are remarkably consistent. Pittsburgh has a somewhat greater requirement, but Columbus and Detroit have about the same need, especially for Class III systems. There is a good distribution of heat requirement shown in Table 2, hence there is need for considering three distinct classes of systems. In Pittsburgh for example, design rates of 89,157 and 275 Btu per (hour) (sq ft) indicate that snowfall occurs in all types of weather.

Operating times varying from three to five percent are indicative of the frequency of substantial snowfalls. Columbus records show the least frequent use, but even there the system would operate for an expected time of about 300 hours per year. Pittsburgh has the greatest need and Table 2 indicates the operating time would be nearly 600

TABLE 4—YEARLY OPERATING DATA, NORTH MIDEAST REGION

City	Idling			Class	Melting	
	Time,[1] Hr. per Year	Rate[2] Btu per (Hour) (Sq. Ft.)	Output,[3] Btu per (Year) (Sq. Ft.)		Time,[4] Hr. per Year	Output[5] Btu per (Year) (Sq. Ft.)
Detroit, Mich.	1790	49.0	87,600	I	134	5540
				II	134	6850
				III	134	7070
Columbus, Ohio	1383	45.0	62,200	I	105	3590
				II	105	4180
				III	105	5350
Pittsburgh, Pa.	1445	49.5	71,500	I	182	9050
				II	182	10700
				III	182	11100

[1]From Table 2, Column 3 × 3630 (hr per year).

[2]Rate when idling, Btu per (Hr) (Sq Ft) = (0.27V + 3.3) (32 — t), where V = wind velocity from Column 5, Table 2, and t = air temperature from Column 4, Table 2.

[3]Product of the two preceding columns.

[4]Hours of Snowfall, from Column 7, Table 2.

[5]Based on the condition that surface temperature is maintained at 33 deg until required output exceeds design output, at which time design output is used regardless of required output. Distribution of required output based on Table 2.

hours per year assuming an idling period of twice that for actual melting.

Operating loads are not so consistent as design loads in this region. Pittsburgh has the greatest heat requirement, and in addition the most frequent use. The operating cost, therefore, is about twice as high in Pittsburgh as it is in Columbus. Detroit costs fall between those for Columbus and Pittsburgh. Idling costs vary from seven to ten times the melting costs, if the system is to operate at the idling rate for all periods when the air temperature falls below freezing.

Such a ratio indicates that it would be impractical to idle a system unless fuel costs were of little importance. One example of such an operation is for buildings using district steam. The condensate could be subcooled to heat the antifreeze. The cost of heating, then, would be zero since costs are based on quantity of condensate rather than heat content.

In summary, snow melting systems in the North Mideast region are practical. Operating costs are not high, but the operating time is substantial. There are three distinct heat requirements for the three classes of systems, but even the maximum requirement for melting would be a little over 11,000 Btu per (year) (sq ft).

(*The October installment of this series will cover the West Central Rocky Mountain region.*)

Air Conditioning Aids Allergy Victims

Within ten years hay fever—generic term for all allergies activated by summer's pollen—will be virtually unknown, except to those whose activities keep them outside in the pollen-laden August and September air; this is the prediction made by George S. Jones, Jr., managing director of the Air-Conditioning and Refrigeration Institute.

Mr. Jones points out that all forecasts agree that in a decade the non-air-conditioned home will be as rare as the refrigerator-less kitchen is today. "Besides the many other advantages of air-conditioning, the fact that pollen is filtered out of the cooled, dehumidified air it provides is a particular boon to hay-fever sufferers," he says.

Many of the estimated 10 million pollen-allergy victims already have discovered the benefits of air-conditioning in their offices, in restaurants, stores, and public buildings, and have joined the group which each year grows by many thousands the ranks of Americans who live in air-conditioned comfort.

The ARI director pointed to rigid laboratory tests conducted last year by Dr. Orren D. Chapman, professor of bacteriology at New York State University of Medicine in Syracuse, which showed that air-conditioning reduced the amount of pollen in a test room by 98% over that registered outside at the height of the ragweed season. In Dr. Chapman's tests it was found that, despite the fact that doors were opened as much as 20 to 30 times each day, pollen counts in the air-conditioned test room averaged well under one grain per cubic yard of air—so low the room could be considered virtually pollen-free.

At the same time, a non-air-conditioned test room located next door with windows open, showed pollen counts as high as 37.3 grains per cubic yard.

Generally, a count of six or seven grains per cubic yard of air in a room is capable of producing an allergic reaction in some people, according to Dr. Chapman. The higher the count the greater the number of hay-fever sufferers affected.

All test procedures were conducted in accordance with standard technics recommended by the pollen survey committee of the research council of the American Academy of Allergy.

In addition to filtering pollen out of the air, the modern air-conditioner or system contributes to well-being of the hay-fever sufferer by keeping temperature and relative humidity constant. Tests have shown that temperatures between 70 and 75 deg., with relative humidity of about 50%, are best for these unfortunates, and that sharp temperature changes tend to aggravate the condition to a certain extent, another reason why those working in air-conditioned offices, stores, and other places of business have found that going home to similar conditions helps to curtail their discomfort.

Also of great importance, according to doctors, patients who sleep in air-conditioned rooms get a good night's rest, vital in building the body's resistance to other diseases which might otherwise strike those who are fighting an allergy, and may at the same time be rundown for lack of sufficient rest, according to Mr. Jones.

Indicative of the Federal Government's recognition of the health benefits of air-conditioning for victims of hay fever, heart disease, and other ailments, is the Internal Revenue Service's recent ruling that the cost of an air-conditioner, plus operating costs, are deductible as a medical expense if recommended by a physician.

Interest Developing in Air Conditioning of Factories

D. C. Minard, president of The Trane Company, reports that a nationwide survey just completed by his firm notes a definite trend toward air conditioning of factories in the United States to promote employe comfort and efficiency. This is distinct from air conditioning employed in some industrial plants for industrial processes.

The trend toward factory air conditioning is rapid, especially in the south where 75% of new factories, and 50% of all factories, will be air conditioned for employe comfort by 1960.

The Case of The Heatless Boilers

E. J. UPDRAFT

Partner, Sketchwell and Updraft, Engineers

M'UNCLE ABNER UPDRAFT is a Special Engineering Consultant in our office, which means he undertakes to solve the unsolvable problems of other engineers. He looks somewhat like Abraham Lincoln, and on this cold November morning, he had to act as soothing as Honest Abe with an engineer who was so upset he shook all over.

"Updraft," said this gent, shivering in his whiskers. "I'm Wilbur Springbow, consulting engineer, and my office is filled with lawyers. They are about to sue me for $100,000, beginning at 9 o'clock tomorrow morning, because the heating systems I designed for my last seven clients won't carry the load."

His teeth clicked and his shoulders jiggled up and down at least seven times, and he wiped the perspiration twice from his forehead before he was able to continue.

"I'm ruined!" he chattered. "Updraft, if you don't help me, they'll take the shirt off my back!"

M'Uncle Abner said gently:

"What did you do: undersize the systems or use poor equipment, or both? I can't set aside the laws of nature, you know."

"I swear," shivered Wilbur Springbow, "I sized the job right, with plenty of safety. As for the equipment, would you call Wetbottom boilers poor? Or Winton? Or Jones Brothers? Or Halsey and Weiss? Standard makes, every one. The same with the firing equipment, three of them stoker fired, three oil and one gas. Why I didn't even ask Snowbird Boilers to bid, and everybody knows you can get their stuff for 20% under the standard makes, and I hear they work well, too."

Shivering, he got up and paced back and forth in front of Miss Fanny, M'Uncle Abner's secretary, and made her so nervous she took her coffee break twenty minutes early.

"Updraft," he quavered, "you must help. You've got to get heat out of those heatless wonders and save my life. Will you do it?"

M'Uncle Abner leaned back in his chair and bellowed across the office:

"Miss Fanny! Slip a couple of dimes into that coffee machine while you're there, and bring two cups back here, will you?"

Then he addressed Wilbur Springbow thusly:

"Wilbur," he said, "a heating system that's designed right, installed right, and uses the right materials, works like it's intended to work, right? I guess we're down to the installation. Who installed these systems?"

The engineer turned up his collar, turned it down again, clicked his teeth, and managed to control himself long enough to say:

"Four jobs were put in by the Heatwell Company, and three by A. K. Smokebox, Inc. Everything according to specification, which I certified, so they're in the clear. They've no idea what's wrong. Updraft, do you believe in black magic?"

"No," said M'Uncle Abner. "Not black magic. But I believe in black ethics and black coffee. Here, drink this and calm down."

He handed the paper cup to Wilbur Springbow, who promptly spilled it down the front of his coat.

"Sorry," he said. "I'm too nervous even to hold a cup."

M'Uncle Abner looked at him over the rim of his own steaming cup.

"Who can gain a profit Wilbur, by discrediting your jobs?"

The engineer considered.

"Maybe the Snowbird people. They've offered to replace every one of my jobs with Snowbird boilers for $50,000 and if the customers are not satisfied, I don't pay them a nickel. This offer holds until tomorrow morning, then the price goes up 10%. They say their foundry, which supplies the cast iron sections, has jumped the price to them."

"Wilbur," said M'Uncle Abner, unraveling his long legs and standing up, "Go tell the lawyers you've just hired the best machinery bloodhound in the United States. And tell the Snowbird salesman to bring you a contract, all ready for your signature, at 9 o'clock tomorrow morning."

"You mean I should take their offer?" Wilbur Springbow quavered.

"I mean exactly what I say and no more," said M'Uncle Abner. "Now give me a list of your seven heatless installations, and stay in your office until you hear from me."

After Wilbur Springbow had shaken his way through the door, M'Uncle Abner packed his special instrument case, which made him look like a doctor on the prowl, and he said to his secretary:

"Miss Fanny, we've got a half dozen heating engineers in this town. I want you to call every one, and ask him, confidentially if he has been having trouble recently with standard make boilers, and none with Snowbird boilers. Then find out for me how long Snowbird has been in production, who their officers are, what foundry they buy from, and where they get their money."

M'Uncle Abner

Miss Fanny took this all down in shorthand, so she wouldn't miss anything.

"You suspect there is some connection between Snowbird boilers and Mr. Springbow's heatless boilers, Mister Abner?"

"Miss Fanny," smiled M'Uncle Abner, "I've never practiced suspectin' out loud, and I don't reckon I'll start now. Just wait patiently and, like Christmas, the answer will come to you."

M'Uncle Abner's first stop was the Bowman House, a small apartment hotel, with two Halsey and Weiss, stoker-fired boilers, in the basement.

"Yesterday," growled the man on the desk, "we had four tenants move out because they were cold, and three today. Tomorrow we're starting suit against that phony engineer who designed the system."

"You're wasting your time," said M'Uncle Abner cheerfully. "No court will find against an engineer who designed according to present best practice and used top-flight equipment. And anyway, tomorrow you shall have either full heat, or the reason why you don't. I promise, and I'm the best machinery bloodhound in the United States."

The clerk sniffed and slapped his arms across his chest and blew out his breath in a white gust that travelled three feet before him.

"When I stop seeing my wind," he said, "I'll believe you."

M'Uncle Abner then went down to the boiler room and laid out his instruments on a work table like a doctor about to do an operation in the patient's kitchen. In sequence he checked the stack draft, the stack temperature, the temperature of the feed water, and the speed of the stoker. Draft and stocker speed were normal, but the stack temperature was excessive, probably because there was more than a wisp of flame in the breeching. Feed water temperature was low, which M'Uncle Abner expected as the vacuum return pump was pulling more vacuum than a system like this normally called for.

M'Uncle Abner next put the boiler name-plate data in his notebook, and he measured the height, length and width of the heatless wonder, because he remembered having seen a boiler with the wrong name plate on it, and he could verify this from a catalog which he had back in his office.

He was now down to a study of the piping arrangement, and he went over it like an ant hunting candy, even listening to its inner workings with a stethoscope in order to pick up any distant circulation troubles like air or water pockets, or maybe a weeping relief valve. But he couldn't find anything wrong anywhere and, to put it frankly, M'Uncle Abner felt all silted up. He sat down on the work table and considered the situation and finally he said to the boilers:

"There's a bug in you somewhere, but right now I can't see it. Maybe it will show up plainer in one of Wilbur's other jobs, which we shall now go and see."

He sneaked past the desk clerk who was talking on the telephone in a steamy cloud of his own breath, and steered himself to each of the other six jobs in turn. Like the Bowman House design, each appeared to be a smartly engineered, first rate installation, and by the middle of the afternoon M'Uncle Abner went back to his office without finding the bug, if any.

Miss Fanny met him with her notebook in one hand, a pencil in the other, and an air of excited expectancy all over.

"You got everything all explained, Mr. Abner?"

M'Uncle Abner smiled like a man walking past the graveyard at midnight.

"Patience, Miss Fanny. A hen takes twenty-four hours to lay an egg, and you're askin' me to lay a gremlin, which is much bigger, in less. You make all my calls, like I told you?"

Miss Fanny tilted her pretty head and studied her notebook.

"Three engineers say they've had a little trouble, not much, and Snowbird boilers are O. K. The Snowbird company's been building boilers for two years, their credit's not too good, and their money's from local men, but I can't find out who. They get their cast iron sections from the Myerstown Foundry Company. The officers are all employees. Do I help you any, Mr. Abner?"

"Sure. Just by lookin' pretty," said M'Uncle Abner sort of absent-mindedly. "Meanwhile, I've got to talk to some gentlemen, both near and far."

"Meaning I should call the foundry?"

"Correct first guess, Miss Fanny."

M'Uncle Abner talked at least $15 worth of long distance telephone with the foundry people and all he learned was that somebody else, name unknown, was also selling cast iron sections to Snowbird.

"We don't make enough sections for all the boilers they're putting out," explained the Myerstown manager. "But they won't identify our competitor. One of our salesmen thinks he saw some used sections going into a job, but I don't believe they'd do a thing like that. Their stuff is making a good record."

M'Uncle Abner next talked with the local salesman of Halsey & Weiss.

"You test every boiler before it leaves the factory?"

"Not ever one," said the salesman, "only prototypes. They're alike as two peas. The funny thing is, nobody complains in other parts of the country—only around here. Could something be smelling, Abner?"

"Could," said M'Uncle Abner. "But right now I don't know what."

Then he called his secretary and said:

"Miss Fanny, time's a-wastin' and I reckon we better put down the facts of this case. Your pencil sharp? Good. Fact 1, the trouble is local. Fact 2, each of these heatless boilers is a low pressure steam boiler, built up of cast iron sections. Fact 3, only reputable boilers are falling down on the job, while the Snowbird units, only two years in production, are doing fine. Fact 4, each of the trouble installations was put in either by the Heatwell Company, or by A. K. Smokebox, Inc., both long established contractors. Fact 5, in each case the firing equipment is putting out more heat than the boiler can absorb, as shown by the appearance of flames in the breeching. Fact 6, from an engineering viewpoint every installation is first class, but it doesn't do its job. Fact 7, right now I don't know what's wrong. You got all that Miss Fanny? Then write it up in capital letters and set it down right here on my desk, under my nose, where I can study it."

While Miss Fanny was typing up the facts, M'Uncle Abner got himself a cup of black coffee from the coffee machine and he put his No. 12 shoes on his desk top, and turned his patient Abraham Lincoln expression out the window, where the November sun was getting ready to bunk down for the night and leave our town's heating to a bunch of boilers that apparently didn't know how to boil.

After he studied the facts for awhile, and had another

cup of coffee. M'Uncle Abner said to Miss Fanny:

"You remember that boiler house fire a couple of years ago? The one where the flames came out the top of the stack?"

"I sure do, Mr. Abner. I said flames couldn't go that high, but they did, because the insides of the boiler had been burned out and you said there was nothing to stop them. Do you think Mr. Springbow's boilers are burned out, too?"

"Miss Fanny," said M'Uncle Abner suddenly looking like a cat on a canary diet, "I reckon I'm about to become either the town genius or the town idiot. In the circumstances I don't mind telling you that Mr. Springbow's boilers are not burned out, in fact I saw their innards myself. Now will you please get Mr. Springbow on the telephone?"

When he got his line through to Mr. Springbow, M'Uncle Abner addressed him in a voice that was like a cat purring beside the fire. "Wilbur? Listen Wilbur. Meet me in the boiler room of the Bowman House at five o'clock. Bring your own lawyer, and as many of those gents who are suing you as you can find. Also tell the Heatwell Company and A. K. Smokebox, Inc., that they had better be represented. Also bring with you one policeman, an ice pick, and a ball-pein hammer. Got it all? Good!"

At 5 o'clock the boiler room of the Bowman House was sure enough full of people when M'Uncle Abner walked in, his long legs moving deliberately, and his Honest Abe face looking grave but satisfied. He nodded to the desk clerk who was there out of curiosity, and had caught a cold and was sniffling unhappily, and then he took the ice pick and hammer from Wilbur's shaking hands.

"Gentlemen," said M'Uncle Abner, like he was opening an extraordinary session of Congress, "listen closely, because the sounds that you are about to hear are of vital importance to everybody here, and to some who are not here."

Then he pushed the ice pick through the insulation on the boiler, right about where the first iron section would be, and when the pick stopped and would go no farther, he rapped it smartly with the hammer. The sound was the solid sound of steel on iron. Next, M'Uncle Abner moved the pick about 8 inches toward the back of the boiler, pushed it through the magnesia insulation, and rapped it again. The sound was like the first.

"Look Updraft," interrupted one of the contractors, "I put this boiler in, and it has twelve cast iron sections, and they all sound like that. What're you trying to prove?"

M'Uncle Abner studied the speaker with the same expression in his deep-set eyes that Abraham Lincoln had when he turned on his Union generals while they were being chased by the Confederate armies all over the state of Virginia.

"Sir," said M'Uncle Abner, "on the record your boiler has made in this hotel, I reckon a sensible person would want to just hold still and listen. Especially you should listen to section No. 7."

Sure enough, when the pick got into section No. 7, and the hammer rapped on it, the sound came out like a hammering on a hollow, sheet-metal box.

"Good Lord!" gulped Wilbur Springbow, so surprised he didn't even shiver a little bit. "What's in there, Updraft?"

"A piece of sheet metal, a dummy section, to put it bluntly," said M'Uncle Abner, and if he looked a little smug, it was because he knew he wasn't going to be the town idiot, at least not this night. "Numbers 8 and 9 sections will sound likewise. Listen!"

He tapped sections 8 and 9 smartly and they too sounded hollow and light, just like number 7. Then M'Uncle Abner smiled and handed the ice pick and hammer to Wilbur Springbow.

"When you release heat in a boiler furnace," he explained to those who didn't know, like the lawyers, "it goes right into the heating surfaces of the boiler, unless some of these have been removed by burning out or otherwise, and then it goes up the stack, usually in the form of red flames. I reckon you'll find about 25% of the cast iron heating sections in this boiler have been removed before the boiler was installed, and the sections then sold to the Snowbird company. Gentlemen," he smiled at the two contractors who were looking as though they could use an open window to jump through. "Since you now see that the laws of physics cannot be set aside to make a fast buck, I think I can leave you to the efficient attention of Mr. Wilbur Springbow, his lawyer, and the policeman who is standing in the doorway."

Having spoken thusly, M'Uncle Abner wished them all a pleasant good-night, and departed from the boiler room, his long-legged, lanky strides seemingly more deliberate than ever as he walked down Main St. in the chill November dusk.

Methods of Control of Atmospheric Pollution

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There is a great difference between the problems of air pollution today and those of a few years ago. Not only is the magnitude of the problem, which exists today, many times greater, but the increasing use of gasoline, gas, and oil have caused many complications that had not been foreseen during the era of soot and flyash.

IT was once supposed that if coal burning could be stopped and petroleum fuels substituted the problems of air pollution would vanish. It is ironical that we could always do something in eliminating soot and flyash from the atmosphere, but thus far have been able to do relatively little about the pollution caused by liquid and gaseous fuels.

The emphasis being given today to problems of atmospheric pollution seems entirely concerned with more extensive and expensive surveys. Every known method is being studied to get more data on the kind of particles we have to deal with, what they do and what kind of instruments can sample with greater precision than those used yesterday or the day before. There exists the unfortunate idea that surveys get the answer.

The Problem

No criticism of surveys is implied, other than that they seem endless. If it is found that particles are of a certain degree of fineness *F* and are composed of compounds *X*, *Y* and *Z*, and that they come from sources *A*, *B* and *C*, then another survey is instituted to obtain data on their physiological—or perhaps meteorological—effects. These surveys seem to be a substitute for work on elimination or control, but time is fast running short and we had best do something in a hurry.

The problem facing the air pollution engineer today is complicated in that it is no longer just air-borne particles that he must contend with. Chemical vapors and radioactive substances are included and are even more difficult to do much about. The tremendous tonnages of automobile exhaust gases and particles daily evolved in all large cities quite defies the imagination as to how to proceed with air cleaning even though the sources of air pollution are known. The problem continues to grow in size and it cannot be long before either something is done or else many activities associated with modern living and progress must come to a halt.

While no one thus far has seen fit to define succinctly just what constitutes the air pollution problem, it is in the final analysis simply the development of *means for eliminating air pollution at the source of generation*. This objective seems to be overlooked. The approach thus far has been with regard to collection of data on the extent and nature of atmospheric pollution in the hope that once this is understood, the means for solving the problem are easily applied. The danger from this approach is that, (1) each passing day the magnitude of the problem increases, and (2) there is no certainty that efficient methods exist to cope with the problem. Added to this is the unfortunate complication that no one seems to know *how clean* clean air should be. A paradox arises if we require that all contributory sources of air pollution should be controlled to the extent that air emitted after cleaning be as dirty or cleaner than the ambient air.

Atmospheric pollutants vary with city, altitude, wind direction, traffic density, distance from sources and many other conditions. Now that fines are contributed by petroleum and gaseous fuels to a large extent, there is no easy method of catching them. They are the kind of particles which go deep into the lungs; the particles which irritate the eyes and respiratory system; the particles which cause the major meteorological changes in the complexion of our cities.

As for gases, vapors and mists, the quantity is also enormous and as in the case of particulate fines there are no simple means of eliminating them.

The capacity of our atmosphere is not limitless as many would like to think. At the present rate at which fossil fuels are being consumed, a few short years will suffice to render some of our cities uninhabitable. Our problem is to find a way out of our dilemma. The discussion which follows gives a brief appraisal of what we have on hand and what we must do by way of further research and development if we are to survive.

Methods

Significant methods of control can be divided into the following groups. (1) Dilution (use of chimneys), (2) Arresters (including inertial collectors, filters, precipitators and other devices for capturing particulates), (3) Scrubbers, sorbers, catalytic agents and means especially used for chemical vapors and mists. For our evaluation we shall consider both efficiency of removal of specified pollutants, economic feasibility and practicality. The last mentioned item is of concern only as regards size. For example, it is not inconceivable that a method of control can greatly exceed both in area and volume, the actual operations giving rise to a pollutant. In fact, in this connection, we may well need to get accustomed to the possibility that the method of control may well exceed in size, first cost and operation cost the very operations giving rise to pollution.

Dilution

The use of tall stacks and chimneys to achieve a dilution of waste delivered to the atmosphere can find only limited application. Not only is the effectiveness of a stack dependent upon its height, and mean velocity and

direction of prevailing winds, but the method also is subject to the whims of weather which causes inversions at the most unexpected places. It is conceivable that one or two stacks may be quite effective; a third or fourth may saturate the upper atmosphere so that the pollution is merely transferred to another nearby locality. Stacks are not positive means of controlling pollution. In fact they add much to the permanent background of pollution existing over most inhabited land areas.

On the other hand, stacks and chimneys, when feasible, can handle tremendous quantities of pollutants. While initially very costly, their maintenance is quite low. Stacks should never be built without making certain of the pattern the pollutants will develop as they emerge to the open atmosphere, nor should it be presumed that the atmosphere is limitless in extent and that the contributions of other nearby stacks can be ignored.

A stack should be ancillary to other more positive methods whenever possible and should not be considered as sufficient by itself. It is certainly not a recommended method of control.

Arresters

This category of air pollution control equipment is concerned with the removal of particulates by deposition. It comprises a rather extensive array of devices, but in general, their classification breaks down into three subgroups: (1) Inertial separators, (2) filters and (3) precipitators. Combinations of any two of these methods are not uncommon where either high efficiency of particulate removal is called for, or else the primary collector is used for reducing the dust load. Of all the methods used for collecting solid air pollutants before discharge to the atmosphere, arresters are perhaps the most widely used. Our discussion concerns the applications and probable effectiveness of arresters.

Inertial Separators. These devices are of two forms—(1) centrifugal, as exemplified by cyclones and rotary equipment and (2) trajectory, which are typical of cinder catchers, louver-type collectors, etc. When properly designed, nearly all types of inertial collectors have the same efficiency of collection for similar dusts. They are best used for industrial applications and are, on a cost per unit volume of air handled, the cheapest method of controlling particulate matter.

Inertial separators are quite ineffective when handling particles below 10 microns unless (as in the case of cyclones) the concentration is very high in which case mass effects tend to increase collection efficiency to very high values. However, such effects are possible only when particle concentrations exceed 100 gr per cu ft, a situation that is rarely the case with most air pollutants. As a rule, efficiencies of all kinds of inertial collectors rarely exceed 90% on a weight basis for particles greater than 10 microns; more generally, efficiencies of 80% or less are attained.

Filters. Thus far, filters constitute the most effective means of controlling atmospheric pollutants. It is possible to secure almost any kind of filter for handling any type of particle with any desired degree of efficiency. This can be said of no other method of particle collection known.

The main drawbacks to filters are (1) their efficiency depends on the pressure drop and rate of flow. The higher the efficiency of collection needed the higher is the pressure drop for the same rate of air flow. For a given filter, the efficiency of collection is enhanced if the air flow is reduced. (2) The size of units needed for handling relatively small quantities of dust-laden air is prohibitive. Thus, economics limit the use of filters.

Some filters are effective in reducing dust concentrations by as much as 80-90% on a weight basis with pressure drops of a fraction of an inch of water at rates of 100 cu ft per square foot of filter. Unlike inertial collectors, particles as small as one micron are captured. Collection efficiency with finer particles than one micron decreases rapidly.

If particles finer than one micron must be captured, filters become very dense and their initial clean resistances may amount to several inches of water gage for volumes of less than one cubic foot per minute per square foot of filter surface. Whereas, the cost of an ordinary throwaway filter amounts to a few cents per year for every square foot of filter at air flow rates as high as 100 cfm per sq ft of filter, a filter having a 99.99% efficiency on a weight basis for particles as small as 0.1 micron would cost several dollars per year, but filtering at one-hundredth the rate of the throwaway filter. The added first cost, replacement and maintenance would render a filter for collection of 0.1 micron particles economically prohibitive.

It may be possible to use low resistance filters with a high degree of efficiency by incorporating certain features. Thus, a good deal of improvement is possible by using plastic mesh which produces frictional electricity when air moves through it and thus charges the dust particles, rendering them more susceptable to capture. Unfortunately, such filters are not very effective when the relative humidity exceeds 60%. Other modifications include the use of an electrostatically charged mat. Neither method is too effective for particles less than one micron. Filtration of aerosols is based on particle-collector contact. The superposition of electric field leads to induced charges and filter-particle geometry plus particle motion affect collection, often not necessarily for the better.

Finally, mention should be made that most effective filters are temperature and weather sensitive. Considering the conditions under which they must be applied, it is doubtful that they are universally practicable, regardless of their effectiveness.

Precipitators. Precipitators refer to those methods of collection of mists and particulates which depend on the use of an electrostatic field. This method, of which there are several forms, is highly regarded and considered the most promising of all control devices for atmospheric pollutants. While precipitators indeed have many desirable attributes, they are not necessarily as fool proof or efficient as might be desirable.

Electrostatic precipitators—curiously—are more effective for collecting micron than sub-micron particles. The startling demonstrations of high efficiency with tobacco smoke arises from mass-cloud effect. Single particles or dust in low concentrations are not so easily handled. The chief reasons why the electrostatic precipitator cannot be an ideal collector is that particles take time to move in a resisting medium such as air, and the finer the particles the quicker is its motion once begun dissipated. Further more, the charge on a particle changes and in certain situations can reverse its polarity. With the air of electro-

static precipitation in its present state of knowledge, it is doubtful that even a precipitator with collector plates of several feet in depth can be effective in increasing efficiency of collection more than a few per cent. Present efficiencies on a weight basis are quite high for precipitators, but for most part not much over 92%. The equipment is both massive and costly to operate. Efficiencies are dependent on weather conditions, frequency of cleaning and other factors. Much still remains to be done before precipitators can be relied upon for all dust problems.

Control of Chemical Vapors and Mists

The difficulties of collecting very fine particles is magnified many times as we approach molecular dimensions. This is the situation as regards vapors and gases. It is necessary to resort to entirely different methods of collection than can be used for particulates. Whereas with particles deposition arises from physical stoppage of particle motion, in the case of vapors and gases the element of time plays an important role. Unlike particles which in motion have well-defined trajectories, the molecules of vapor and gases have random motion and the process of collection must depend on diffusion. The collection for vapors and gases depends on an intimate contact with a suitable collecting surface or medium with the concentration of the vapor or gas both the air and contact surface, with temperature and with the kind of molecules dealt with as represented by a so-called diffusion coefficient. Actually, the problem of vapor and gas collection is one called "mass-transfer." It is a slow process though there are methods of speeding it up. The most difficult aspect of any mass transfer process is to collect a vapor when its concentration is low. It is the magnitude of the difference in concentrations between the vapor and contact surface which constitutes the driving force achieving effective collection. The following discussion serves to indicate what is at present available for eliminating vapors and gases at their sources.

Scrubbers (Absorbers). These devices can also be used for particulates, but are rather uneconomical. They are better suited to handle vapors and gases. The method consists in generating a fine spray in a chamber through which the vapor laden gases pass. The effectiveness of collection is enhanced in many instances by using a chemical spray with low vapor pressure which reacts with the gases present. Other forms of scrubbers consist of towers packed with coke through which trickles a suitable absorbing liquid while the vapors to be removed pass upward in counter-current fashion. These devices give more intimate contact and have a high efficiency. A new and very effective device utilizes the venturi principle. The gas and air move through a dust system which diminishes in diameter to a throat. In this throat a suitable absorbing fluid is injected and the high rate of shear causes a very fine spray to form, thus giving a high degree of contact surface in a small space. The fact that the stream is highly turbulent also increases effectiveness.

All scrubbers depend on the principle of absorption already explained. Contact time being important, coupled with the usual low concentrations dealt with, units of rather large dimensions are called for. Rates of flow must necessarily be low. Hence, both the initial cost of equipment and its operation are high. Many vapors and gases are also corrosive and rapid deterioration cannot be overlooked. Absorption devices as exemplified by scrubbers are best applied to situations where the volume of vapors to be controlled is not large.

Adsorption. This is a method which shows much promise, but which has not been used too much except for recovery of vapors having commercial value. In its usual application, an adsorbing substance (a material which shows preferential sorption of a gas or vapor) is placed on trays or in permeable containers and the vapor laden air passed through it. The process is fairly rapid, but depending on the concentration of vapors handled, the life of the adsorbing medium is relatively short. The cost of regenerating the adsorbing medium may be quite high.

Thus far, adsorption has not proved too successful for general application. It is too costly, though as mentioned, very effective. There is need for a good deal of research in this connection during the next few years. The essential details of what is needed will be discussed later.

Catalytic Agents. These depend on the conversion of a vapor from one form to another. Thus a substance called "Hopkilite" can convert carbon monoxide (a very dangerous gas) in air to carbon dioxide (a gas used by plants). Since the conversion is accomplished without affecting the agent itself chemically, it is called a catalytic process.

The conversion of a gas or vapor to a different gas or vapor either gives off heat or requires heat. In the case of Hopkilite, the amount of heat is very great and unless removed can ruin the catalyst and its container. Catalysts are also affected by small quantities of substances called "poisons". Thus, platinum metal, useful to convert SO_2 to SO_3 in making sulfuric acid, is rendered ineffective by very small quantities of arsenic in the gas stream.

Catalytic agents are best applied to problems involving organic vapors. They should, with more research and development, prove useful in handling the problem of automobile exhaust gases, of odors from rendering plants, and other situations. There is much work to be done in connection with catalytic agents, especially as regards the design of practicable units. But it must not be presumed that catalysts can be used generally. They cannot be successfully applied to a large number of gas and vapor pollutants for which absorption methods are better suited, *e.g.*, NO_2, HCl, etc.

Other Methods for Control of Air Pollutants

In addition to the physical and chemical methods described for the control of atmospheric pollutants, there is another very useful and important approach—anmely, *substitution* within the process giving rise to pollutants. The approach is more useful with chemical vapors since any fuel substitute does not necessarily eliminate the production of water product. Substitution refers to (a) altering the process in such a way using substitute agents so that the production of atmospheric pollutants is either eliminated or reduced, or (b) the development of a substitute end product by other means than previously considered feasible or possible, so long as the end product involves the production of no air pollutants in its manufacture. It is clear that when the substitute method is possible, it represents the most positive means of ending air pollution. Examples are the use of steel shot instead of sand blasting and peening castings eliminated the production of dangerous silica dust, and the substitution of solvents having a low volatility in place of benzene for spray

painting which reduced the hazards of explosion and danger to health. Many other examples can be cited.

The method of substitution should receive far more attention than it has received. Often it simplifies and betters a process and may even make it more economical.

Efficiency of Collection and Reference Standards

We have throughout our discusion used the term efficiency as meaning the weight of material captured to that in the incoming air of a collector. It is usual to express efficiency as a percentage. No difficulty arises insofar as gas, vapor and mist collection is concerned. With particulate matter, efficiency on a weight basis leaves considerable room for criticism.

We must recognize that if we express efficiency in a weight basis that we are not only concerned with numbers of particles, but also their volume, size by size. Since volume, and hence mass, varies as the cube of dimension, a single 10 micron particle is the equal of one million particles 0.1 microns in diameter. Thus, it is possible with a few large captured particles to give the impression that a collector is working more efficiently than it actually is. It is clear that some other means must be developed for gaging efficiency preferably on a size frequency basis. Thus, if there are N_i particles per unit volume entering a collector having a mass mean diameter D_i and there are N_o particles per unit volume leaving with a mass mean diameter D_o, then the efficiency of collection might well be represented by a simple expression Efficiency $= (1 - N_oD_o^3/N_iD_i^3)\ 100$. This allows for numbers in a mass mean diameter basis. Measures of this kind have been suggested by the ASME, but as yet do not seem to find favor. Enforcement of air pollution legislation is dependent upon a suitable definition of control efficiency: the method used must also be practicable and reliable.

The question of the meaning of efficiency of collection and enforcement is also allied with the kind of equipment available for control. To demand higher efficiencies in existing equipment than such equipment is capable leads to ineffective enforcement. We must demand of collectors performances compatible with the state of the air. Either control is achievable within the meaning of an ordinance for control of air pollutants with the best of available equipment, consistent with economic reality, or else the operations causing air pollution should be eliminated. It is not fair to demand collector performances beyond the capacity of existing equipment.

Need for Research

It is quite clear from what has been said that there is no single method in itself adequate for removing air pollutants. In so far as particulates are concerned, the method used depends upon the extent of removal desired coupled with economic feasibility. With noxious gases and vapors, we must be resigned to relatively large cumbersome equipment, but with perhaps greater assurance of success. In any case, there is need for improvement and a new approach to the overall problem of control. The procedures described below are those being studied at Georgia Institute of Technology and are part of a long range program dealing with aerosols. The various techniques are based on rather radical procedures. For, instead of improving on existing equipment and methods to attain higher efficiencies, these new methods are based on utilizing the properties of the pollutants present in the air.

Aggregation. This method of control is based on the property of many aerosols to grow and aggregate readily in the presence of certain vapors. The line of attack is to study conditions accelerating aggregation, so that the particles are no longer fine, but consist of small clumps. Thus, if the process by some means can proceed to the point that very large clumps are formed, ordinary collector equipment can be used with a high degree of efficiency. Thus, the procedure is to alter the aerosol so that it is more easily handled.

Electrets. These consist of small electrostatic "magnets" which when blown into an aerosol cloud tend to either collect particles already charged or induce charges on uncharged particles so that they are attracted. This method shows considerable promise and as with aggregation, it permits the use of existing collector equipment for control.

Thermo-Deposition. This method functions in a manmanner similar to a parallel plate electrostatic precipitator, but uses a thermal field instead of an electrical one. The collector plates are placed close together with plates alternately hot and cold. A very high thermal gradient is thus set up and aerosols are deposited on passing between plates on the cold surfaces. The highest collection efficiencies as yet attained with any device have been achieved in our laboratory. The method could prove of considerable value, but still requires developmental work. Energy demands are high.

Supercoolants. These may function in some cases. As yet, because the aerosol concentrations to which they apply are very high and critical, there use seems limited.

Catalysts. These will prove feasible for automobile gases and organic vapors. The need is for the development of a durable all-purpose catalyst, and a mechanical arrangement for utilizing the heat generated. A "closed" system to deliver heat energy to a booster might yet render these methods as important economically as in removing pollutants. Much more emphasis should be put on this method than has been the case thus far.

Adsorption. There is finally the use of adsorbents not as fixed beds, but as clouds in the gas stream and turbulently mixed with it. The adsorbent can be removed by use of cyclones and filters and regenerated for re-application. The procedure here indicated has not been used or even developed to its full capabilities.

Recapitulation

The writer has endeavored to show that the time has come to devote greater attention to the problems of control. Surveys and ordinances are not the answer and in fact postpone progress. The increase of air pollutants year by year without attention to control devices may lead to serious consequences.

It is estimated that during the next ten years more than two billion dollars will be spent on control equipment, most of it inadequate to control the finest particulates or the gases and vapors which in the long run tend to build up pollution "background" throughout the world. Not only are the producers of air pollutants responsible, but the manufacturers of control equipment to an even greater extent for failure to carry on fundamental work.

The cost of air cleaning will be costly. There are no easy ways of solving the overall air pollution problem; but it is about time that some definite action be taken other than talking about it.

LOUIS BLENDERMANN ON

PIPING AND PLUMBING

Flexible Arrangement of Rest Room Facilities

PROVIDING the proper number of fixtures, including water closets, urinals and lavatories for the occupants of a building, always requires planning by both the architect and the engineer. Local plumbing codes in each area prescribe the minimum number of fixtures required for the occupants in various types of buildings, but often the number of fixtures so defined is not sufficient to serve the needs of the new type buildings being erected.

The current tendency is to provide the number of fixtures that seem most adequate for the number of occupants to be served, even though the amount may exceed the number allotted by the local code. Because proper consideration is given to the toilet facilities for a building, the new rest rooms are beginning to resemble the neat and sanitary appearance found in a private home.

Old Style Buildings

Years ago, it was thought adequate to provide in a building one rest room with two or three water closets and one or two lavatories to serve all the occupants on that particular floor. Each floor was treated in the same manner. The size of the rest rooms and the few fixtures contained, reflect the slight importance placed on such rooms. With the introduction of local plumbing codes, new strides were accomplished through minimum standards governing the type and number of fixtures to be provided.

With the increase of women employees in industry and commerce, attention had to be given to toilet facilities for women to provide proper accommodations. Thus, in many of the old buildings it became necessary to create separate rest rooms for the women. At first this was achieved by assigning the rest room on one floor to serve all the men on two floors and the rest room on the other floor to serve all the women on both floors. Later on, new rest rooms were installed on each floor for the women. As the number of employees increased, further modifications became necessary. Many of these original office buildings are still in use, having experienced three or four complete alterations to the rest rooms to offer the adequate facilities needed.

At present our country is enjoying one of the greatest full employment periods of all times. Most of the available buildings are occupied and filled to capacity. A result of this situation is that further alterations are now in progress to provide the additional toilet facilities so sorely needed in industrial plants, factories, government buildings and other types of buildings.

New Style Buildings

New buildings are being erected throughout the nation. In addition to being functional, such buildings include air conditioning, good lighting and many other refinements for the well being and comfort of their occupants. Equally important, the rest rooms are carefully planned to offer the highest degree of sanitary cleanliness, besides containing the adequate facilities needed.

Modern Rest Rooms

A new and realistic concept has taken place in rest room planning. A modern office building, for example, often has toilet room fixtures in excess of the local plumbing code requirements.

New style fixtures and toilet stall partitions permit that degree of cleaning and maintenance to assure the high standard of sanitary cleanliness expected.

No longer is the rest room treated as a space that should be confined to minimum dimensions; it is designed as a space intended for the comfort of the occupants. It plays an important role in the benefits or refinements that a building owner offers to his tenants, or a company offers to its employees.

A modern rest room enhances any building in which it is installed. Since employees spend as many or more of

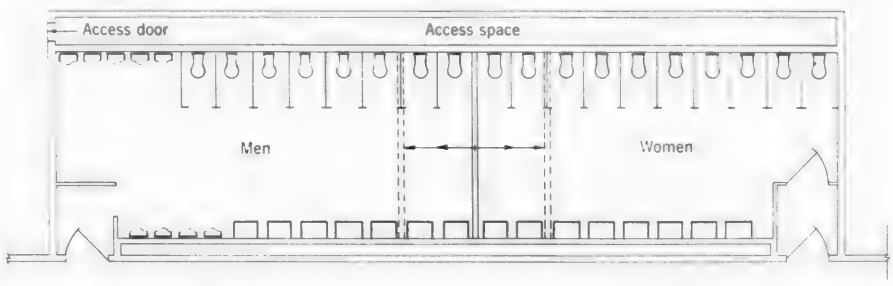

Fig. 1. Typical arrangement for rest rooms, showing how divider wall can be moved to gain the number of fixtures needed for either room.

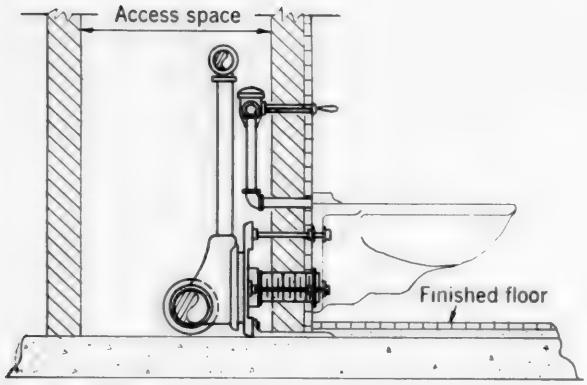

Fig. 2. Detail of access space for wall-mounted fixtures.

their hours at their place of work as they do at home, the significance of the rest room becomes evident.

Fixture Arrangement

Although modern toilet facilities can be provided for the men and women occupants of each floor, there still remains the problem of just how many fixtures should be provided to serve the changing needs of the occupants without the necessity of future alteration.

The factors that contribute to this consideration are the variable number of persons that will occupy a particular floor at some later date.

Using an office building for example, one floor may be occupied by a sales organization that employs a fairly even number of men and women. Suppose, a few years later, this space is rented by an insurance company that employs twice as many women as men. The chances are that the toilet facilities for the women will not be adequate.

There are several ways that this situation can be handled. Figure 1, illustrates a typical layout of adjoining men's and women's rest rooms and shows how a flexible arrangement of toilet facilities can be accomplished.

As indicated by Fig. 1, the rest rooms are designed so that they are adjacent to one another. The divider wall between the rest rooms is constructed of that type of masonry that can be torn down and rebuilt elsewhere, or it is constructed of steel of the type that is easily relocated. The particular wall construction to be used is determined by the architect. To gain additional fixtures for either the men or women, it is necessary only to move this wall in the proper direction.

This method of providing flexibility is not alone limited to office buildings but may be used in almost all other types of buildings. The urinals in the men's rest room are placed at the far end of the room so that they will not be affected by the wall relocation.

This means of flexibility is practical because it permits the allotment of the proper number of fixtures as desired for each specific rest room, and it is economical since it avoids the extra cost that would otherwise result from the installation of needed fixtures.

Fixture Roughing

The roughing for the fixtures shown in Fig. 1, is not involved by any relocation of the divider wall. The roughing should nevertheless be designed to offer every advantage for maintenance and repair of the equipment concealed in the pipe space. An access space will provide the necessary means for this effort. Moreover, an access space will permit the ease of adjustment or repair of concealed flush valves should the need arise.

Figures 2 and 3 show the details of a typical access space.

The access space shown in both figures is 24 in. In general, this width is adequate for a single battery of water closets or the fixtures illustrated. This space affords ample room for a man to walk through the space and perform his necessary tasks. Figure 2 shows the arrangement of roughing and facilities when wall type fixtures are used while Figure 3, shows the arrangement when floor type fixtures are used. Sufficient lighting in the access space will greatly simplify the maintenance work.

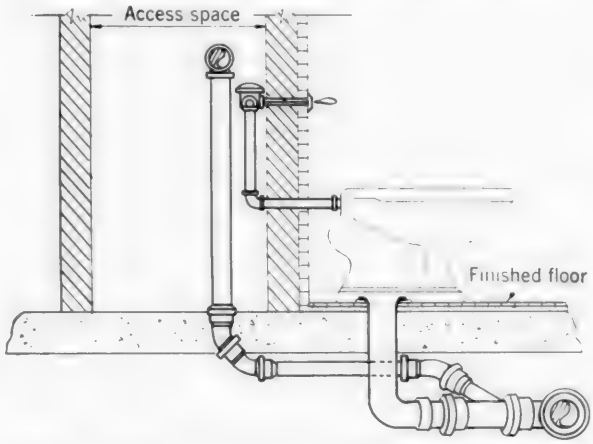

Fig. 3. Detail of access space for floor-mounted fixtures.

An access space avoids the shutdown of the rest rooms when repairs or adjustments are performed on the equipment. This feature thereby allows for uninterrupted fixture service. For large size rest rooms, this consideration is an important one.

It might appear that an access space utilizes too much valuable floor space. Actually, the upper portion of the access space generally houses the ducts that are required for the ventilation of the rooms. Access doors represent a modern trend in design and are being considered in many of the new projects currently being erected.

Error in August Data Sheet

The back of the data sheet in the August issue, which was devoted to a table entitled "Heat Losses From Bare Steel Pipe" was, unfortunately, in error.

The top portion of the table covering Horizontal Pipes gave values of "Heat Loss per Lineal Foot of Pipe, Btu per Hour." The bottom portion of the table, covering Vertical Pipes, referred to "Heat Loss per Square Foot of Pipe Surface, Btu per Hour." This latter was in error as the vertical pipe data also are in terms of "Heat Loss per Lineal Foot of Pipe, Btu per Hour."

AIR CONDITIONING, HEATING AND VENTILATING'S

An Introduction to Nuclear Radiation and to Nuclear Engineering

Part 2

F. W. HUTCHINSON

Professor of Mechanical Engineering, University of California, Berkeley, Calif.

In this second and concluding section of Professor Hutchinson's two-part article on nuclear radiation and nuclear engineering (Part 1 appeared in the July issue), he discusses artificial radioactivity, stable isotopes, nuclear energy, radiation damage, radiation effects on materials, and concludes with the radiation effects on human beings.

An Introduction to Nuclear Radiation and to Nuclear Engineering—Part 2

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7. ARTIFICIAL (INDUCED) RADIOACTIVITY

One of the most important consequences of the use of nuclear power has been the great need of protecting against radiation from materials and systems which in themselves are not naturally radioactive. In a nuclear powered locomotive, for example. the frame itself would become radioactive as a consequence of bombardment from particles escaping from the reactor. This induced radioactivity would provide a hazard which would require consideration in terms of maintenance, inspection and repair. For an appreciable time after shutdown of the reactor there would be hazardous radiations emitted from materials which had been made artificially radioactive; these would continue to afford a problem of personnel protection for some hours. Fortunately the radioactivity induced in most materials is relatively short-lived so the decay of the radioactive materials soon mitigate the hazard.

Aluminum, for example, is transmuted through radioactivity to an isotope which loses ½ of its activity (has a "half life" of) less than 3 minutes; its significant activity continues at reduced rate for a matter of approximately half an hour. Magnesium, on the other hand maintains significant radiant discharge for some two hours after the induction of radioactivity has ceased. Copper, if made radioactive, admits gamma radiation of significant amounts for up to a week (and for one artificial radioisotope of copper for up to one and a half years).

The above statements are qualitative only. but they serve at least to indicate that one major potential hazard in connection with nuclear powered equipment is not merely that parts or components may be physically damaged. but in addition that they may receive enough induced radioactivity to become hazardous secondary emitters of radiation which. in its turn. may either damage material or constitute a health hazard to personnel.

Typical Nuclear Bombardment Reactions. All three of the radioactive metals mentioned above become radioactive as a result of bombardment by neutrons. Thus. for aluminum the reaction is

$$_{13}Al^{27} + {}_{0}n^{1} \longrightarrow {}_{13}Al^{28} \qquad (26)$$

The equation indicates that plain nonradioactive aluminum having 13 protons in its nucleus and a total of 27 particles (protons plus neutrons) receives within the nucleus an added bombarding neutron to be changed to the heavier (28) radioactive isotope of aluminum, $_{13}Al^{28}$. When this new radioactive atom of aluminum undergoes spontaneous decay, it emits an electron (with conversion of a neutron to a proton) and a gamma ray and is thereby transmuted to a new stable (nonradioactive) atom of silicon. Thus, the effect of inducing radioactivity in aluminum is twofold: 1. The radioactive material is hazardous as an emitter of gamma radiation; 2. The combined bombardment—decay process has changed an aluminum atom into an atom of silicon with obvious structural effects.

The process with magnesium is similar to that with aluminum. Neutron bombardment from the reactor causes a magnesium atom to change to a heavier isotope of the same metal. The new radioactive atom then decays by beta and gamma emission and is transmuted to aluminum. It need hardly be emphasized that if part of a machine is made of a magnesium alloy and if part of that part is subsequently found to have transmuted to an aluminum alloy that fact will be of interest to the designer—to put it mildly.

(a) The neutron-gamma reaction and its significance with respect to reactor shielding. The examples given above of radioactivity induced by neutron bombardment were selected because of their obvious significance with respect to radiation damage of structural parts. A different, but equally significant bombardment effect is that due to activation of materials which are intended to act as radiation shields. In selecting a shielding material for neutrons, for example, a preferred one would absorb the neutrons without then becoming a gamma emitter. From another standpoint, a highly effective gamma shield would still fail of its purpose if, exterior to it, was a neutron shield which emitted gamma radiation. Evidently, therefore, the selection, arrangement and integration of reactor shielding will require consideration of neutron-gamma reactions and the characteristics of individual materials with respect to them (silicon, for example, is changed by neutron bombardment to an heavier radioactive isotope which then decays, *without* emitting gammas, to stable phosphorus).

(b) The gamma-neutron reaction and its significance with respect to shielding. A reaction opposite to that considered in (a) above occurs when a gamma ray of sufficiently short wave length (hence, high frequency and large photon energy) strikes a nucleus and knocks out a neutron. The reaction, called photodisintegration or nuclear photoeffect, stops (shields) the gamma radiation, but causes a secondary neutron bombardment (with consequent atomic transmutation) which may constitute an almost equal damage problem or health hazard. For highly energetic gammas (possessing energy of the order of 20 Mev) one gamma photon may be responsible for the releas of two neutrons or of a neutron and a proton.

Method and Significance of "Activation". The term activation refers to the induced change—due to bombardment—of a nonradioactive isotope of an element to an artificially (induced) radioactive isotope of the same element. When the stable material is subjected to a high flux of fast neutrons (of the order of 10^8 or 10^{10} neutrons per square centimeter per second (a flux commonly found in reactors), the material picks up an amount of activation which depends on the time of exposure to the flux. If the material is exposed for a time long with respect to its half life, it will reach a maximum degree of radioactivity or a state of "saturation". If then removed from the flux the induced radioactivity will be found to decrease as an exponential function of time. After approximately ten half lives the magnitude of the radiation will no longer be of significance. This last point can be misleading, however, unless it is realized that very wide differences in half life occur: Carbon, for example, is made artificially radioactive as C^{14} which is used in some types of tracer experiments in biological research; the half life of C^{14} is 5580 years. Radioactive nitrogen, on the contrary, has a half life of only 7 seconds.

Methods are available in the literature for calculating activation times leading to saturation as a function of neutron flux density; further discussion of this subject is beyond the scope of this introductory presentation.

8. THE CHART OF THE NUCLIDES

Some years ago Dr. Emilio Segre proposed a graphical presentation of practically all available information concerning the elements and the various isotopes of each (except such elements as beryllium, aluminum and phosphorus which exist with only one weight of atom). Subsequently, Dr. Segre's presentation was modified and expanded to its present form, the "Chart of the Nuclides", as now published by General Electric Company. Complete familiarity with the material on this chart is a fundamental requirement for anyone working in the field of nuclear engineering. In the following paragraphs the construction, meaning and use of the chart will be covered in some detail. (Throughout the following discussion the reader should have available a copy of the chart).

Selection of Abscissa and Ordinate. In setting up a graphical arrangement of the nuclides the most logical coordinates would be the building "blocks" of which the nuclei are composed. One might plot protons versus neutrons or versus the total number of nucleons within each atom. The chart as now prepared uses the atomic number, Z, as the ordinate (y axis); thus, the y scale gives the number of protons in a particular nuclide and (the same number) the electrons present in a stable atom based on that nuclide. The abscissa (x axis) gives the number of neutrons; hence, it is a scale of the atomic mass number, A, minus the atomic number Z. The resultant rectangular plotting (refer to Fig 14) provides a small square for each of the various isotopes.

As indicated on Fig 14 all isotopes having the same number of protons (that is, all isotopes of a given element) lie along a horizontal band. Isotopes of different elements, but having the same number of neutrons (isotones), fall in a vertical band. Isotopes of different elements but having the same mass (that is, the same total number of protons and neutrons) fall along a diagonal from upper left to lower right; such isotopes are called isobars. For reasons which are not yet well understood, isotopes having either Z or A-Z equal to 20, 50, or 82 (or 126 for A-Z) are unusually stable; for this reason these particular values of Z and A-Z are known as magic numbers; on the chart of the nuclides the isotopes corresponding to magic numbers are set off from the others by unusually heavy lines.

The printed versions of the chart of the nuclides will be observed to differ in form from Fig 14 in that only that section, or strip, of the chart is presented which contains known isotopes. Thus, by selection and by regrouping, the printed chart appears as three diagonal bands of isotopes, but the coordinates and the significance is exactly as shown in the illustrative figure.

Identification of the Chemical Element. In the box at the far left of each column (refer to Fig 15) the so-called chemical element is given. Thus, in Fig 15, the element lead is identified by its symbol, *Pb*, by its *chemical*

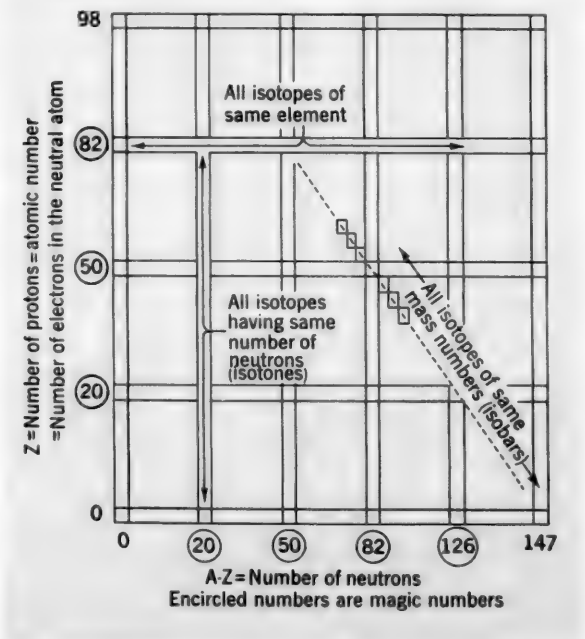


Fig. 14. Arrangement of the chart of the nuclides.

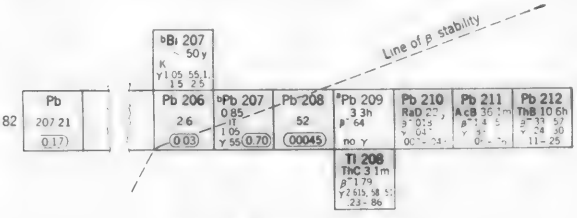


Fig. 15. Types of isotopes.

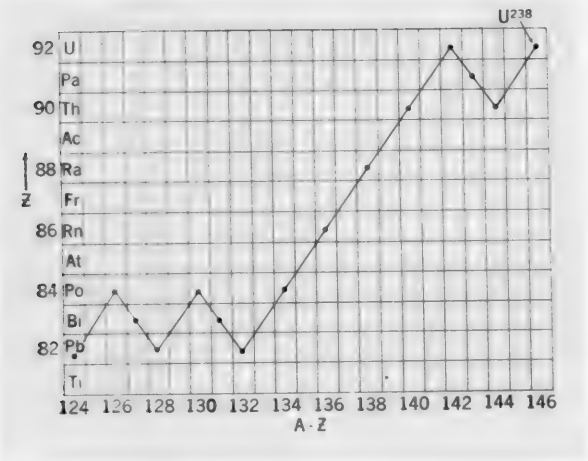


Fig. 16. The uranium series.

atomic weight. 207.21. (that is, the weight of the mixture of isotopes of lead as found in nature) and, in the oval, by the "thermal neutron absorption cross section. in barns". 0.17. The latter number is indicative of the relative statistical effectiveness of the particular element in stopping low speed neutrons (as from a reactor) by absorption: although the value is given as an area (one barn is equal to 10^{-24} cm^2) it does not have direct significance as such. but is rather a term showing the relative probability of thermal neutron absorption.

Stable Isotopes. The isotopes of an element that do not possess radioactivity are said to be stable, unchanging, and are shown on the chart in squares (refer again to Fig 15) which are lightly shaded throughout. Thus, lead has two completely isotopes. one having a mass number of 206 and the other 208. For each stable isotope the square gives the symbol and mass number, as Pb 206. with a number below—in this case 26—which gives the percentage abundance of that particular isotope in the element lead as found in nature. At the bottom of each square, in the oval. is given the thermal neutron absorption cross section in barns.

Stable Isotopes with Isomeric States. At some mass numbers—as 207 for lead (refer to Fig 15)—isotopes are found which though normally stable nonetheless do sometimes exist in a radioactive state. Such isotopes are shown on the chart with a shaded section which includes the same information as that for a normally stable isotope. In the lower left corner. however, is an unshaded square which gives the half life—0.8 seconds for lead 207—the method of radioactive decay (the symbol IT meaning isomeric transition and indicating that there is no particulate discharge during decay. hence no change in either atomic or mass number) and the photon strength of the gamma radiation which will be emitted as the isomer decays to the stable state: in the case of lead 207 it is indicated that two gamma rays are emitted. one photon having an energy of 1.05 Mev and the other 0.55 Mev. The existence of a radioactive isomer in common with a stable isotope is usually transient and results from previous radioactive decay of some other isotope with delayed emission of the gamma radiation.

Naturally Radioactive Isotopes. Referring again to Fig 15, many elements as found in nature have isotopes which are radioactive. These are shown on the chart in squares which give the symbol of the element and its mass number (as Titanium 208) its half life (as 3.1 minute for Ti 208). the mechanism of decay and the energy of the emitted radiation (as, for Ti 208. an electron having 1.79 Mev and four gammas having 2.615 Mev. 0.58 Mev. 0.51 Mev and from 0.23 to 0.86 Mev).

(a) Long Half Lives. Isotopes having long half lives. as uranium 234. are identified on the chart by squares with black top sections and a shaded reminder. Long half lives usually are of the order of hundreds of thousands of years or more.

(b) Short Half Lives. The chart identifies isotopes of this type by squares with black top sections, the remainder of the square being unshaded. The isotopes of lead with mass numbers of 210. 211. and 212 (refer to Fig 15) are examples of this type of isotope. Reference to the full chart will show many isotopes which are identified as having "short" half lives even though the time is of the order of tens of thousands of years.

(c) Typical Decay Processes. All naturally radioactive isotopes decay by emission of some type of charged particle. the element being transmuted thereby to another and more stable isotope of some other element. The two most common forms of natural radioactive decay involve either the emission of a beta particle in a reaction such as (refer to Fig 15)

$$_{81}Ti^{208} \longrightarrow {}_{1}e^{0} + {}_{82}Pb^{208}$$

or the emission of an alpha particle in a reaction such as

$$_{92}U^{235} \longrightarrow {}_{2}\alpha^{4} + {}_{90}Th^{231}$$

In all such cases the radioactive chain of decay continues until eventually a stable isotope is formed.

(1) The uranium chain or "series". Fig 16 shows the series of decay processes followed by uranium 238 as it decays to eventual stability as lead 206. The equation giving the processes in this series is

$$_{92}U^{238} \longrightarrow {}_{2}\alpha^{4} + {}_{90}Th^{234} \longrightarrow {}_{1}e^{0} +$$
$$_{91}Pa^{234} \longrightarrow {}_{1}e^{0} + {}_{92}U^{234} \longrightarrow {}_{2}\alpha^{4} +$$
$$_{90}Th^{230} \longrightarrow {}_{2}\alpha^{4} + {}_{88}Ra^{226} \longrightarrow {}_{2}\alpha^{4} +$$
$$_{86}Rn^{222} \longrightarrow {}_{2}\alpha^{4} + {}_{84}Po^{218} \longrightarrow {}_{2}\alpha^{4} +$$
$$_{82}Pb^{214} \longrightarrow {}_{1}e^{0} + {}_{83}Bi^{214} \longrightarrow {}_{1}e^{0} +$$
$$_{84}Po^{214} \longrightarrow {}_{2}\alpha^{4} + {}_{82}Pb^{210} \longrightarrow {}_{1}e^{0} +$$
$$_{83}Bi^{210} \longrightarrow {}_{1}e^{0} + {}_{84}Po^{210} \longrightarrow {}_{2}\alpha^{4} + {}_{82}Pb^{206}$$

One deviation in the above chain occurs in that a small amount of bismuth 214 emits an alpha particle to transmute to thallium 210 which then emits a beta in decaying to lead 210; the remaining step, alpha emission with transmutation to lead 206. is the same as for the main series.

Fig 17 shows a similar decay series leading from thorium 232 to lead 208, whereas Fig 18 shows the actinium decay chain from uranium 235 to lead 207.

From considerations of the above series it is at once evident that if one started with an initially pure block of uranium 238, or thorium 232, or uranium 235, the block would soon contain varying numbers of atoms of

many elements. Fig 19 illustrates this point by indicating the types of atomic "impurities" that would develop in uranium 235. Eventually (at time infinity, in theory), the entire block would be degraded to stable lead 207.

Artificially Radioactive Isotopes. By means of nuclear bombardment, stable isotopes can be made radioactive. Lead 209, for example (refer to Fig 15), is an artificially radioactive isotope with a half life of 3.3 hours; it decays by emitting an electron (with no attendant gamma emission). All artificially radioactive isotopes are shown on the chart of the nuclides in unshaded squares.

(a) With isomeric states. In some cases two radioactive atoms of the same radioactive isotope share different methods of decay. In such cases they are said to constitute isomeric states. Osmium 191, for example, occurs in one isomeric state having a half life of 14 hours; this isomer decays by isomeric transition (no particulate emission) through discharge of a 0.074 Mev gamma ray to become its "sister" isomer of the same isotope; the latter state is a radioactive isotope with a half life of 16 days which decays with emission of an electron and two gamma photons.

Transuranic Elements. Uranium is the heaviest element found in nature and uranium 238 the heaviest natural isotope (note on the chart of the nuclides that two heavier artificially radioactive isotopes of uranium have been manufactured). By processes of nuclear bombardment a group of man-made elements have been transmuted from natural isotopes. This group, all consisting of elements heavier than uranium, are known as the tranuranic elements. It is probable that the number of transuranic elements will increase.

Positron Production. In some cases artificially radioactive isotopes decay by converting a proton into a neutron, thus decreasing the atomic number by one while leaving the mass number unchanged. When this occurs the reaction is of the form

$$_{65}Tb^{158} \longrightarrow {}_{+1}e^{0} + {}_{64}Gd^{158}$$

The symbol $_{+1}e^{0}$ indicates a positively charged particle having the mass of an electron and equal charge, but of opposite sign; the particle is known as a positron and, as discussed in the next section, is very short-lived.

Positron Annihilation. Within a fraction of a second after emission from a decaying atom (or after origin through "pair formation") a positron finds an electron, the two charges neutralize one another, and the mass of both electron and positron is annihilated through conversion to energetic radiation in the form of a gamma photon. Knowing the rest masses of the two particles the energy equivalent of the gamma can be calculated from Einstein's mass-energy relationship (equation 8) and will be found to equal 1.02 Mev.

Pair Formation (Gamma Conversion). A situation directly opposite to that of positron annihilation sometimes occurs when a gamma ray of sufficient strength strikes a target. If the gamma photon is stronger than 1.02 Mev (the energy equivalence of two electron masses) the gamma may be converted to an electron and an associated positron; in this case the mass of the particles is produced by a conversion from energy (the target is unaffected, acting merely as a kind of nuclear catalyst).

Internal Conversion. In some cases a gamma ray leaving the nucleus of a decaying atom may energize an orbital electron causing it to be emitted from the atom. Note that in cases of internal conversion the electron which leaves is actually a part of the original atom, whereas in the usual case of electron emission during beta decay the emitted particle *forms* during the decay process (in transforming a neutron to a proton).

K-Capture. It has previously been noted that an atom can be transmuted to an element of lighter weight by forming and emitting a positron. The same effect is sometimes realized without positron formation; in this case an orbital electron—usually from the innermost or *K* orbit—is captured by the nucleus and used to neutralize the charge on a proton.

Products of Nuclear Processes. Fig 20, reproduced from an inset on the large chart of the nuclides, shows the way in which isotopes change position on the chart as a result of receiving or losing a particle. Thus, a neutron entering increases the mass number by one, but does not bring about a transmutation. An entering nucleus of the H^3 isotope introduces one proton and two neutrons so the original nucleus is transmited to a new element with atomic number greater by one and with mass number greater by three. An entering duetron, brings in one proton but two nucleons so the atomic number increases by one and the mass number by two. Either emission of a positron or K-capture of an orbital electron reduces the atomic number by one without change in the mass number. The various other displacements shown in Fig 20 can be similarly explained.

(a) Beta Stability. On the chart of the nuclides a dashed irregular line runs diagonally upward and to the right (refer also to Fig 15). This is known as the line of beta stability and approximate being a locus of the most stable of nuclides. Radioactive isotopes to the left of the beta-line often decay toward the line by emission of a plus beta (positron) whereas similar isotopes on the right of the line are likely to decay by emitting a beta particle (electron).

Displacements Caused by Nuclear Bombardment. Most of the problems of interest in connection with radiation

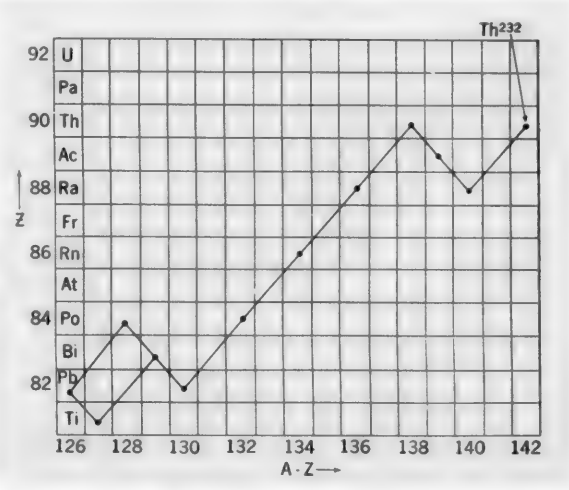


Fig. 17. The thorium series.

damage are caused by nuclear bombardment. Fig 21 (also reproduced from the chart of the nuclides) shows isotopic displacements resulting from typical nuclear bombardments. Thus, if an entering alpha particle knocks out three neutrons, the net effect on the atom is a gain of two protons and a loss of one neutron; the atomic number increases by two and the mass number by one. Similar explanations will be noted for the other displacements that are shown in Fig 21. In connection with reactor shielding two of the most important reactions shown on Fig 21 are the neutron-gamma and the gamma-neutron; these reactions have already been discussed.

9. NUCLEAR ENERGY

In preceding sections various types of nuclear reactions have been discussed and in many cases it was noted that dissipation of energy (often as gamma rays) accompanied the nuclear change. The present section investigates the source and magnitude of the energy associated with nuclear reactions.

Endothermic Processes. By laboratory methods, using particle accelerators such as the cyclatron, nuclear particles can be given sufficient kinetic energy to enable them to enter a nucleus. As an example consider a reaction in which an alpha particle is used to bombard a nitrogen nucleus:

$$2\alpha^4 + {}_7N^{14} \longrightarrow {}_8O^{17} + {}_1H^1$$

The total rest mass entering into the reaction is 4.00389 amu for the alpha and 14.00750 amu for the nitrogen nucleus or a total of 18.01139 amu. The resultant oxygen nucleus has a mass of 17.00450 amu and the proton a mass of 1.00813 or a resultant total mass of 18.01263 amu. Thus, the effect of this reaction has been to bring about a mass increase of 0.00124 amu. This mass must have come into existence as a result of an energy conversion and, since 1 amu is equivalent (by equation 8) to 931.1 Mev, it follows that the bombarding alpha particle must have possessed a minimum kinetic energy of 1.155 Mev. In a reaction of this kind it is evident that the transmutation can only be achieved by *supplying* energy from some outside source.

Exothermic Processes. In contrast to the above case consider the bombardment of a lithium atom with a proton, the reaction being

$${}_3Li^7 + {}_1H^1 \longrightarrow 2_2\alpha^4$$

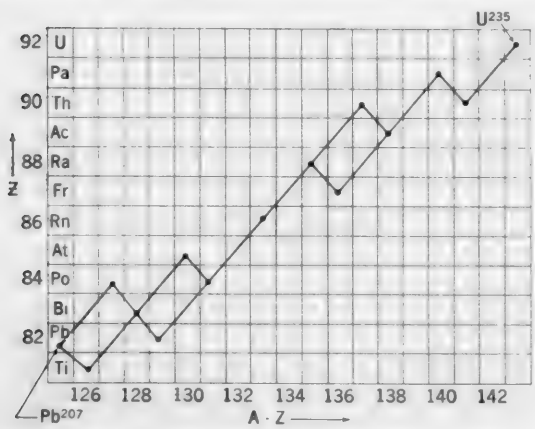


Fig. 18. The actinium series.

Here the original nucleus of 11.6399×10^{-24} gram mass and the bombarding proton of 1.6715×10^{-24} gram mass yield two alphas each of which has a mass of 6.6404×10^{-24} grams. The result of the reaction is a mass reduction of 0.0306×10^{-24} grams corresponding to an energy *release* of approximately 20 Mev. Some conception of the magnitude of mass-energy conversion processes can be obtained by noting that the 20 Mev released in this case is 10 million times as much energy as would have been obtained from the ordinary process of burning one molecule.

Fission Processes. All of the nuclear reactions so far considered, whether due to radioactive decay or to nuclear bombardment have involved transmutation of an element (or mass change of an isotope of an element) as a result of either loss or capture or transfer by the nucleus of a proton or a neutron. In the field of nuclear power, processes of the type already considered are very important in terms of shielding, of radiation damage, and of health hazard. But the very heart of the nuclear power system—the reactor—is based on an entirely different kind of nuclear reaction, the process of fission.

Fission represents an actual breaking of the nucleus, a splitting into large heavy fission products caused by application of external force. One common analogy used to describe fission is that of a drop of liquid. Referring to Fig 22 visualize, as at the left of the figure, a small drop which is maintained by surface tension in practically spherical form. If force is applied to this drop it will elongate, but surface tension will continue to hold it in elliptical form. As the application of force continues the droplet will tend to distort into the form of a dumbbell. In this latter form, considering the drop now to be composed of nuclear fluid, the positively charged protons in the two ends of the dumbbell would be subject to Coulomb repulsion, so that the tendency would now be for the separation to continue; at fission, the two irregularly shaped fragments would each be pulled back into spherical from due to surface tension.

(a) Reactor Principles. In the most common of nuclear reactors the "fuel" or material to undergo fission is uranium, usually enriched with a larger percentage of the U^{235} isotope than is found in natural uranium. The reaction in which the uranium fissions is

${}_0n^1 + {}_{92}U^{235} \longrightarrow$ Fission products + $2\frac{1}{2}$ (statistically) n.

Each U^{235} atom that fissions releases approximately 200 Mev, hence it can be shown that the complete fission of all atoms in one pound of U^{235} would release as much energy as would the burning of two million pounds of coal.

In nature fissions occur, but only in isolated cases as the neutrons released by a fission almost alway are absorbed by some other material before they come in con-

tact with another fissionable atom of U^{235}. By enriching the fuel, however, and by providing means of reducing the speed of the neutrons from fast to thermal it is possible to use one neutron from each fission to bring about a subsequent fission. The basic principle of reactor operation is to slow the neutrons (slow neutrons fission U^{235}, but do not fission U^{238}) and to conserve one, but not more than one, for establishing a chain reaction. If one is not conserved the reaction will cease, whereas if any appreciable number (statistically) more than one are utilized, the subsequent fission rate would increase and the chain reaction would go out of control (as in an atomic bomb explosion).

In so-called breeder reactors one of the fast fission neutrons is used to split a U^{238} atom with subsequent production of plutonium which is itself fissionable. The reaction is

$$_{92}U^{238} + {}_{0}n^{1}\ (\text{fast}) \longrightarrow {}_{92}U^{239}$$

The U^{239} has a half life of 23 minutes and decays to neptunium by the reaction

$$_{92}U^{239} \longrightarrow {}_{93}Np^{239} + {}_{-1}e^{0}$$

The neptunium, with a half life of 2.3 days then decays to the desired product, fissionable plutonium, by the reaction

$$_{93}Np^{239} \longrightarrow {}_{94}Pu^{239} + {}_{-1}e^{0}$$

In usual power reactors, however, every effort is made to thermalize all the fast neutrons.

(b) Types of Moderators. Fig 23 shows diagrammatically the sequence of events in a typical power reactor. A neutron from some outside source, as cosmic radiation, strikes a U^{235} atom. The fission products move apart at high velocity and in opposite direction (to conserve momentum) and there is a simultaneous release of (in this case) three fast neutrons. The neutrons pass through a surrounding material known as a moderator. Selection of a material for the moderator is based on its ability to slow down fast neutrons with a minimum of absorption. In some cases the moderator and the fuel are intimately blended (a homogeneous reactor) while in other cases the fuel is inserted, as a stick of enriched uranium, at intervals through the moderator (heterogeneous reactor).

In the case shown in Fig 23 the moderator absorbs one neutron, allows a second to escape from the system, but thermalizes the third neutron which then goes on to strike a U^{235} atom and repeat the whole series of processes.

(c) Types of Reflectors. Since a requirement for maintaining a chain reaction is conservation of thermal neutrons, it follows that the volume of the reactor must be sufficiently great to permit slowing down the neutrons before they escape. One means of reducing the necessary "critical" size is to enclose the reactor in a material which will reflect or divert the neutrons and turn their path back into the moderator. Such a material, used outside the fuel-moderator section but inside the protective shield, is known as a reflector.

(d) Basis of control. In simplest terms the control of a reactor requires maintenance of conditions such that one neutron from each fission causes a subsequent fission.

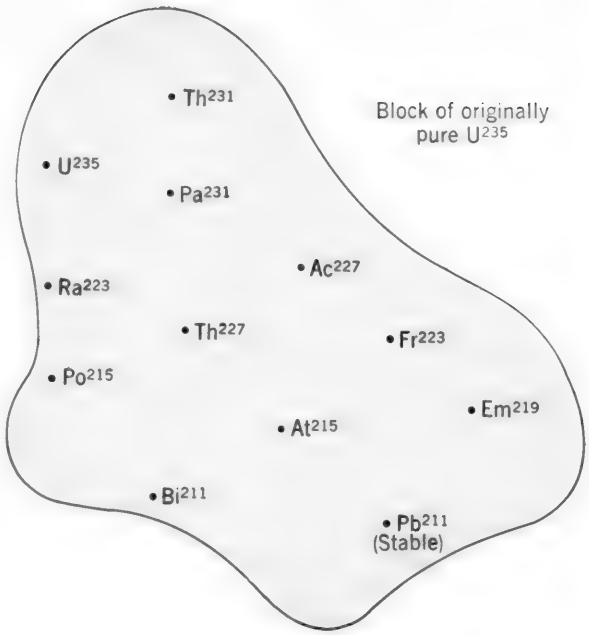


Fig. 19. Atoms of twelve elements in a block of decaying uranium.

If the number is less than one, the number of fission per unit time will continually decrease until the chain reaction ceases and the reactor is inoperative. If the number exceeds one, the number of fissions per unit time will continue to increase until an explosion shatters the fuel-moderator unit and thereby brings the system (in this case systems!) volume below the required critical value. Thus, control requires having the number less than unity while reducing the power, greater than unity while increasing the power, but essentially unity at any time, and for any power, during which the power output is to be held constant.

From the foregoing discussion it follows that control is achieved by altering the rate at which neutrons are absorbed. Control rods made of material which has a high capacity for neutron absorption are lowered into the reactor case when it is desired to decrease the power or to shut the system down. Conversely, raising the rods decreases the neutron absorption and thereby increases the number of fissions per unit time.

(e) Principles of Shielding. To produce 20,000 hp as power a nuclear reactor would have to operate at a rating of the order of 100,000 hp. Assuming leakage from the shield as 2% of this amount would give radiation from the shield at a rate of 2000 hp. At a distance of some 20 feet from the reactor a man would receive only about one thousandth of this or 2 hp. Human tolerance to radiation, however, is limited to reception at the rate of one hundredth millionth of a horsepower (over a forty hour week) so that it is very evident that the problem of providing adequate shielding is indeed a serious one.

Fortunately shield thickness is proportional to the log of the strength of the source so that the weight or thickness goes up slowly for increased power. Thus, if a two foot thick shield were adequate for a source that was one hundred times too strong a three foot thick shield would suffice for a source one thousand times too strong.

The design of shielding is beyond the scope of this presentation. However, shielding principles (that is, the mechanisms by which different materials absorb or attenuate radiation) are of fundamental importance in terms of radiation damage and will receive detailed consideration in a later section.

Fusion Process. The process of fission involves the breaking up of a heavy element nucleus into two or more lighter element nuclei. Fusion, on the contrary, is a process in which the nuclei of a light element are combined to form the nucleus of a heavier element. During the process of combination the rest mass decreases, so that a corresponding (and very large) quantity of energy is liberated.

(a) Solar Source and Activation of the H-Bomb. For many years scientists wondered concerning the energy output of the sun. Solar radiation occurs at a rate of over 100 million million million kilowatt-hours per second, yet the sun has continued to exist for a period inestimably longer than could possibly be explained if this energy release were a result of the usual process of combustion. Finally, in 1929, a theory was expounded which justified the sun's long existence by explaining the huge energy liberation as a mass-energy conversion (in accord with Einstein's theory as summarized in equation 8). The sun now is known to liberate energy as a result of a thermonuclear, or fusion, process in which hydrogen is transmuted to the heavier element helium. In providing its great stream of radiant energy the sun converts 4 million tons of mass per second into energy (as a mass defect in the hydrogen-helium fusion process), yet according to present estimates it has a remaining life of some 15 million million years.

One basic requirement of the fusion process is an extremely high temperature. Because of this there is no present reason to expect that man will ever be able to use nuclear fusion in a controlled process and for peacetime purpose. It has been announced that explosive fusion has been attained in a hydrogen bomb, but it has also been suggested in the press (unclassified reports on the subject give no adequate answer) that the necessary high temperature needed for fusion was obtained by using an ordinary (!) fission-type atomic bomb to "trigger" the hydrogen bomb.

At present, therefore, metallurgical limitations with respect to temperature indicate that controlled use of fusion is—if at all—for the indefinite future. The justification for inclusion here of material on the subject is to inform the reader to a point such that he will at least not be taken in by recurrent implications in the press that a "harnessed H-bomb" will soon be of use to man: on this subject the engineer can, for once, avoid having to qualify and commit himself with a flat statement that within the present forseeable metallurgical limitations controlled fusion is impossible.

(b) The Proton-Proton Chain. To round out the discussion of nuclear reactions it is desirable to indicate the processes which occur in a typical thermonuclear fusion. The first reaction involves the combination of two protons (recalling that a proton is a hydrogen nucleus) to form a heavy hydrogen nucleus (a deuteron) according to the equation

$$ {}_1H^1 + {}_1H^1 \longrightarrow {}_1H^2 + {}_{-1}e^0 $$

The second reaction is one in which a deuteron and a proton combine to form a helium nucleus

$$ {}_1H^2 + {}_1H^1 \longrightarrow {}_2He^3 + \text{gamma photon} $$

If each of the above reactions is considered to occur twice, the subsequent reaction is

$$ {}_2He^3 + {}_2He^3 \longrightarrow {}_2He^4 + {}_1H^1 + {}_1H^1 $$

The net effect of the five reaction is a combination of four hydrogen nuclei (protons) to form a helium nucleus with associated emission of a gamma ray.

(1) Available energy. The rest mass of four hydrogen atoms* is 4.03258 amu whereas the rest mass of the resultant helium atom is 4.00387 amu. The mass defect, 0.02871 amu is equivalent to an energy release of 26.7 Mev. In the case of the sun one gram of its mass contains 2×10^{23} protons so if all these were used up in fusion the net energy release, for one gram, would be 55,000 kilowatt hours.

Summary of the Concept of Binding Energy. In the case of all nuclides the rest mass of the nucleus is less than the sum of the rest masses of the individual protons and neutrons of which the nucleus is composed. The difference in mass, called the mass defect, is equal (in energy units) to the so-called binding energy. Taking the helium nucleus (an alpha particle) as an example the mass defect amounts to 0.03028 amu. By the Einsteinian mass-energy equation (8) the corresponding value of the binding energy is $0.03028 \times 1.66 \times 10^{-24} \times (3 \times 10^{10})^2$ or 4.52×10^{-5} ergs. The energy per particle (there being four particles in an alpha) is 1.13×10^{-5} ergs and the energy per unit mass is $(1.13 \times 10^{-5})/(1.66 \times 10^{-24})$ or 7×10^{18} erg/gram. In comparison with this value, gravitational energy amounts to approximately 10^5 ergs per gm and the energy released in a "chemical" explosion is of the order of 10^{12} ergs per gm; thus, the nuclear energy release is $10^{18}/10^{12}$ or one million times as great as that of chemical explosion and a billion billion times greater than gravitational energy. These facts give some indication of the reason why nuclear reactors afford such tremendous potentialities as sources of future power.

10. RADIATION DAMAGE

In early nuclear reactors radiation damage was practically a negligible problem. In order to reduce the transmitted radiant flux to a level such that no physiological hazards were involved, it was customary to "overdesign" the shielding to an extent which practically eliminated possibility of hazard of any kind. In considering the use of nuclear reactors for practical applications the situation is quite different. The shield should be as light as possible, hence, must be *designed* to reduce leakage of radiation to an acceptable tolerance value without providing undue safety factors.

*The rest masses of the atoms rather than of the nuclei are used for simplicity because the rest masses of the orbital electrons balance out.

In actual practice the reactor must be partially shielded to prevent radiation fluxes of an order of magnitude such that materials, components, and systems would be either damaged or rendered ineffective. The question, then, is what effect will such radiation have on materials, components and systems which must necessarily be located in the reactor area space. The overall problem involving estimation of the expected flux, recognition of the mechanisms by which damage can occur, test to determine the extent of radiation damage to a given material, and probable further test to determine the combined environmental influences.

Various Classifications. In attempting to establish some basis for estimating or anticipating radiation damage a first requirement is recognition of the kinds and strengths and sources of the radiations which are responsible for the effects produced. Three fundamental classifications can be used:

(a) By type. Radiant bombardment is either of a particulate or of an electromagnetic origin. Bombarding particles include alpha rays, beta rays, cathode rays (betas of lower velocity), neutrons, fission recoil fragments, or positive ions which have undergone acceleration. Electromagnetic waves all have essentially the same characteristics; their fundamental difference is wave length which, in turn, determines photon strength. Typical bombarding waves are gammas "hard" and "soft") or X-rays (of extranuclear origin).

(b) By weight. Light radiation includes betas, X-rays, and gamma rays. Heavy radiation consists of particulate matter of substantial mass: alpha particles, neutrons, fission recoils, and accelerated ions.

(c) By source. The nuclear reactor is itself the source of primary radiation consisting of betas, neutrons, fission recoils, and "hard" gammas. The shielding, or other exposed or activated materials, may be responsible for radiant fluxes due to betas, cathode rays ("soft" betas), accelerated ions, X-rays, and gamma rays (the latter usually resulting from a nuclear reaction in which absorption of a neutron is accompanied by emission of a gamma).

Of the primary radiation it is important to note that only neutrons and gammas present a shielding problem.

Effect of X-Rays and Gamma Rays. In terms of cause of radiation damage all "light" radiations produce their effects indirectly through production of fast electrons which then pass through the material. X-rays and gamma rays produce such electrons by three mechanisms:

(a) Photoelectric Effect. Previously X-rays were shown to occur as a result of bombardment of a target with electrons. The reverse effect sometimes occurs when a target is bombarded with gamma rays; in this case the electromagnetic radiation energizes electrons in the target and knocks them out. Since the gammas differ from light only in terms of wave length the reaction is known as the photoelectric effect. The equation is

$$\tfrac{1}{2}\, m^1v^2 = h\nu - \phi$$

which shows that kinetic energy of the leaving electron (hence its velocity) is the difference between the energy of the approaching gamma photon and the energy, ϕ, needed to free the electron from the surface. The photoelectric effect is one of "all or nothing"; the photon either transfers all of its energy to the electron or else no reaction occurs. For the lighter elements (atomic number less than 30) the photoelectric effect is the major cause of fast electron production for gammas of photon strength less than 0.1 Mev. For elements heavier than lead the photo effect is most significant for gammas of strength less than 0.5 Mev.

(b) Compton Effect. In this case a gamma ray photon acts as though it were particulate in that it undergoes the equivalent of elastic collison with an electron, the electron recoiling at high speed and the reduced photon continuing on to affect other electrons. The Compton effect is the most important cause of damage to light elements (atomic numbers under 30) from gammas having energies between 0.1 to 10 Mev. For elements heavier than lead the Compton effect predominates as a cause of damage from gammas having energies of from 1 Mev to 4 Mev.

(c) Pair Formation. This nuclear process has already been discussed in section 8.10. For the elements having atomic number less than 30 it is the most important gamma reaction for photons of 10 Mev or more. For elements heavier than lead, pair formation is of greatest importance for photon strength greater than 4 Mev.

Effect of Beta (Electron) Rays. An electric current is defined as a charge in motion. Since an electron is a charged particle it follows that a fast electron produces an electric current along its path.

(a) Electronic Current. As the electron moves through the material it excites the orbital electrons of the molecules with which it comes in contact. This effect is the one which, for some types of materials, causes radiation damage.

(b) Collision effects. Fast electrons also engage in elastic collisions but the mass of the electron is so small that no appreciable transfer of energy occurs to the "bumped" atom.

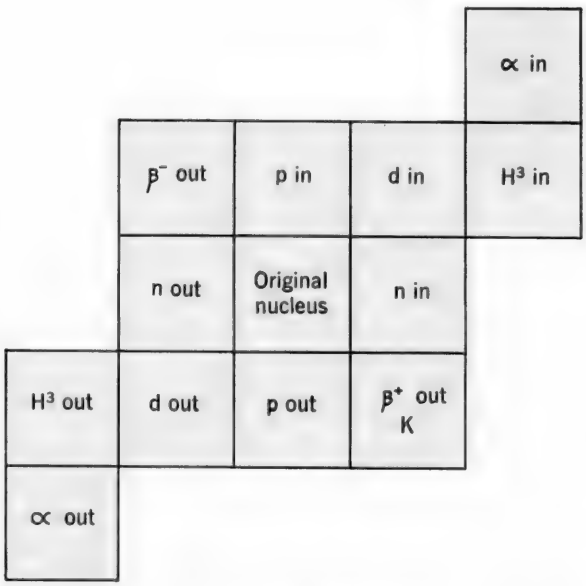


Fig. 20. Nuclear displacements.

(c) Ionization. The moving fast electron produces ionization along the length of its path and this, together with orbital electron excitation, is a major cause of radiation damage to certain types of materials.

Effect of "Heavy" Charged Particles. Fission fragments, positive ions and neutrons are the three types of heavy particles which are of concern. Fission products are initially heavy charged ions, but they have little penetrating power, and hence do not involve a problem outside of the reactor shield.

(a) Ions. Similar in effect to electrons, but of greater mass, ions produce very dense ionization along a very short path.

(1) Fast. As initially formed, fast ions travel through the absorbing material, literally tear electrons out of the orbits, and give them ionizing energy. Such ions have very few elastic collisions, hence, almost the entire kinetic energy which they possess must be lost in the process of transfers associated with electronic excitation and molecular ionization.

(2) Slow. When ions have lost a substantial part of their initial kinetic energy the velocity approaches that of an outer orbital electron. In this case the electron may combine with the singly charged ion to form a neutral atom. But although the velocities of electron and ion were the same, the vastly greater mass of the ion often enable the resultant neutral atom to continue to cause damage either by elastic collision or by continued ionization of the material through which it is passing.

(b) Neutrons. The most significant characteristic of a neutron is that it does not possess electrical charge, so that it can only lose energy as a result of collision. Further, since the neutron is essentially of the same mass as a proton, the most effective means of dissipating its energy is in collision with a proton or another neutron. Fast neutrons, moderate velocity (epithermal), and low velocity (thermal) neutrons are all of importance as causes of radiation damage to material. As previously indicated, thermal neutrons are practically screened out by a relatively thin layer of boral shielding, and therefore this type of neutron is not expected to be of any importance in the region outside the reactor shield of a nuclear-powered airplane. For neutrons of all types three mechanisms of energy loss require consideration:

(1) Elastic collision. If a neutron collides elastically with a particle of practically equal mass a transfer of kinetic energy will occur in amount depending on the type (as direct or glancing) of hit. For a direct hit the energy transfer would be 100%, the neutron coming to a stop and the proton leaving with the same velocity that the neutron had initially. On the average, however, approximately half the neutron energy will be dissipated in each proton collision. Since each reduction in energy of a neutron leads to formation of an ion (the neutron knocks the nucleus of an atom out of its position within the electron orbits and causes it to be positively charged) the overall effect of neutron absorption is ionization. The effect of neutrons is thus the production of fast ions just as the effect of gammas was seen to be the production of fast electrons.

(2) Inelastic collision. When a neutron loses energy by inelastic collision the target gains internal excitation energy with consequent reduction in the total kinetic energy of the system. The effect is somewhat similar to that which occurs when a marble is thrown into a ball of putty. Inelastic scattering may occur with either thermal or fast neutrons and usually results in emission of a gamma ray.

(3) Reactions. Neutrons also are involved in transmutation reactions, but in most cases—*outside* of the reactor shield—the number of such reactions is too infrequent to be of importance as a damage factor. An important exception to this statement, however, is that of capture by a hydrogen atom of a thermal neutron: in this case a gamma ray with photon strength of 2.17 Mev is produced and, by the methods previously indicated, the gamma may be responsible for damage.

11. RADIATION EFFECTS ON MATERIALS

In the preceding section attention was directed to the mechanisms of influence of radiation as it is absorbed or attenuated during passage through a material. Although the eventual mechanisms are the same regardless of either the type of radiation or the type of material, yet the extent, type and likelihood of damage varies very greatly with materials. At the present state of the art it is not possible accurately to predict radiation damage for particular materials for components or systems, but it is possible to estimate damage probability in terms of the general class of material.

With Respect to Type of Bond. The most significant determining characteristic of a material is the type and degree of atomic binding; the three most important types of bond are those associated with covalent, ionic, and metallic types of molecular structure.

(a) Covalent compounds. This classification includes the common gases, liquids and organic materials; it is by far the class of material which is most sensitive to damage by radiation.

Covalent materials are those in which electrons are shared between the atoms of a molecule (in contrast to ionic material in which electrons are transferred between at atoms of a molecule). Damage is caused directly by excitation of orbital electrons leading to ionization and the subsequent destruction of molecular bonds with release of individual atoms or of radicals. For materials of this type the energy required to achieve ionization is greater than the energy need to break a bond; when absorption of radiation takes place and when subsequent neutralization occurs, the energy released in the process of "deionizing" is great enough to destroy bonds; the manner in which the radiation damage manifests itself (as through loss of strength, hydrogenation, etc.) depends on the behavior of the free radicals and varies widely among materials.

For most organic materials the amount of damage done by radiation is directly proportional to the total quantity of energy absorbed and is practically independent of the type of radiation.

(b) Ionic compounds. When, in the process of molecular formation, there is an actual transfer of an electron from one atom to another, the resultant compound is composed of ions and is called ionic (in contrast to covalent compounds which involve "shared" rather than transferred electrons). For compounds of this type there are no real bonds, the lattice of positive and negative ions being held together primarily through electrostatic attraction.

Regardless of the type of radiation (fast neutrons, thermal neutrons, or gammas) the major effects of radiation on ionic compounds such as oxides and salts (NaCl, for example) are ionization and electronic excitation. But since this type of compound is already ionized, there is very little tendency for it to be damaged by ionizing radiation. A typical effect, as with sodium chloride, would be ejection of an electron from an ion to cause a doubly charged positive ion of sodium; this doubly charged ion would soon neutralize, however, and recombine to form the undamaged sodium chloride molecule.

In some cases ejected electrons are trapped in lattice imperfections before they have had a chance to achieve recombination; in these cases the trapped electrons change the isotropy of the material (as glass), develop what is known as F-center and produce localized discoloration.

For ionic compounds containing lithium or boron thermal neutrons also cause some damage by producing recoil ions which neutralize and act as very heavy bombarding particles that may knock whole atoms from their position in the lattice. In general, it requires approximately 25 ev to knock out an atom. For strikes involving less energy than this the "knocked-on" atom absorbs the received energy and manifests it as heat.

$\alpha-3n$	$\alpha-2n$	$\alpha-n$
$p-n$	$p-\gamma$ $d-n$	$\alpha-n, p$
$\gamma-n$ $n-2n$	Original nucleus	$d-p$ $n-\gamma$
$\gamma-p, n$	$\gamma-p$	$n-p$
$n-\alpha$		

Fig. 21. Typical nuclear bombardment reactions and displacements.

(c) Metallic materials. Metals have often been described as consisting of "positive ions immersed in a sea of free electrons". The effect of ionizing radiation is to increase the kinetic energy of the electrons, but since they are free, a subsequent "fall back" to the initial state occurs with no manifestation other than a heating effect. Some damage may occur due to Wigner effect, but in general this is both slight and localized. The three most important radiation damage effects are those due to: (1) Transmutation of atoms as a result of neutron bombardment; (2) Solid state reactions due to "knock-on" atoms; (3) Displacements of atoms.

The principal cause of transmutation is that resulting from a neutron-gamma reaction, the affected atom undergoing a mass increase of one and frequently becoming thereby a radioactive isotope which subsequently decays and undergoes transmutation to an impurity atom.

"Knock-on" atoms in a metal may receive sufficient energy to cause them to vibrate and raise the temperature at that point to well over a thousand degrees. The vibrating atom may effect, in solid state reactions, some 5000 to 10,000 surrounding atoms. The time duration of such "thermal spiking" is of the order of one ten billionth of a second, but the local damage can be severe.

Atomic displacements lead to damage either due to production of a "vacancy" in the lattice (refer to Fig 24) or due to relocation of the knocked-out atom as an interstitial atom (refer again to Fig 24).

Summarizing, high particle energy is largely responsible for ionization and low particle energy for high velocity recoils; most damage is due to fast particles near the end of their paths. Proton bombardment gives recoils for energies less than 10 Kev, atom for energies of the order of 100 Kev, and fission fragments for energies greater than 1 Mev; the latter cause great damage along a small path.

With Respect to Chemical Classification. A further means of estimating or analyzing radiation damage is in terms of the physical characteristics of the undamaged material.

(a) Gases. Practically all gases when irradiated are subjected to many kinds of states in which the orbital electrons become excited. When the incident radiation is sufficiently energetic (28-32 ev per ion pair), some of the atoms become ionized. In the process of ionization the ejected orbital electron will frequently possess sufficient kinetic energy to enable it to ionize another atom; this chain effect is known as "orbital cascading" and may lead to ionization of many atoms as a result of the first electron ejection.

In other cases the ejected electron may contact a molecule which possesses "electron affinity"; when this occurs; the effect is one of decomposition as

$$_{-1}e^{0} + HCl \longrightarrow Cl^{-} + H$$

Usually, however, dissociation results from the neutralized atoms being left (after neutralization from the ionic condition) in an excited state.

(b) Organic materials. Materials of this type are subject to radiation damage with many different effects. In some cases molecular "condensation" occurs with forma-

tion of larger molecules (organic cancer). In other cases the molecules of the original material undergo splitting and are degraded to smaller molecules (organic anti-cancer). Hydrogen (growth of a hydrocarbon molecule through combination with additional hydrogen) is similar in effect to "condensation", whereas dehydrogenation is a special form of degradation.

In estimating damage it is to be noted that approximately four molecules will be affected for each 100 ev of energy absorbed. The number of bonds per molecule will, of course, vary among materials, but on some bases of estimating damage it has been assumed that initial evidence of damage might be expected when 1% of the bonds were broken. This assumption has been placed in question, however, because work at Massachusetts Institute of Technology indicates that damage to bonds occurs selectively; thus if a greater number of weaker bonds are destroyed, the onset of damage might well occur much sooner than if the bond destruction were occurring uniformly throughout the molecules.

In estimating damage to organics the gamma flux expressed in gammas per centimeter squared per second can be converted to ergs by dividing by 2×10^7. For convenience a larger energy unit, the rad, is often used: 1 rad is equal to radiation absorption at a rate of 100 ergs per gram. Thus to convert gammas to rads (for organic materials) divide by 2×10^9. For many plastics and organics a threshold for appearance of radiation damage is

$$4.5 \times 10^6 \text{ to } 7.0 \times 10^6 \text{ rads.}$$

For elastomers and plastics, radiation damage usually occurs with breaking of bonds plus nuclear changes leading to conversion of solids to liquids with associated liberation of hydrogen or of some other gas. For organic fluids the same type of damage occurs, but, in addition, polymerization (as solidification of oils) and coking takes place; a large amount of gas is also liberated. For greases the above types of damage occur plus reduction in lubricating effect. For dielectrics the major damage is caused by neutron absorption and appears as a change in the electrical characteristics.

As an indication of the wide variety of effects experienced due to radiation damage, note that:

Phenolic	swells
Polyester	shrinks
Polyethylene	hardens
Butyl rubber	softens
Natural rubber	becomes brittle

(In spite of this, natural rubber is the least subject to radiation change of all elastomers.)

Nylon: 1. Gains strength
then 2. Becomes brittle
then 3. Darkens
then 4. Becomes more transparent

(c) Metals. Among the changes which occur in metals due to irradiation are: (1) Loss of hardness; (2) Loss or gain of strength; (3) Change in creep rate; (4) Change in ductility; (5) Acceleration of corrosion.

Factors Influencing Radiation Damage. The four factors which determine the likelihood, the type and the amount of radiation damage are: (a) The material; (b) Size of the components; (c) Type of radiation; (d) The energy absorbed.

(a) The material. Discussed previously.

(b) The size of the components. In one type of nuclear bombardment reaction a thermal neutron is absorbed with release of a gamma. The gamma then releases or excites an orbital electron and it is the electron which is responsible for damage. For a very small component it is evident that the gamma might escape before affecting the electron, hence the small component (if of the order of 3 inches by 3 inches by 3 inches or less) will be less subject to damage than would be a larger one.

(c) The type of radiation. This subject was covered in principle in part 10. As an additional specific example of the influence of type of irradiation, note that:

1. In germanium, a fast neutron can knock a whole atom out of a lattice, producing heavy ionization over a short path.
2. In germanium, a gamma photon is not energetic enough to knock out atoms, but it "hits" orbital electrons causing light ionization over a long path.

(d) The energy absorbed. Absorption of radiation by any material is influenced by six factors:

(1) Reactor power. Obviously the amount of radiation reaching a given location will vary as a function of the power being produced.

(2) Reactor shield. By use of extensive shielding around the reactor the rate of radiation loss can be reduced to a negligible value.

(3) Location of the component. The attenuation of radiation follows the inverse square law, so that as the object is located at a further distance from the radiant source the rate of irradiation falls off very rapidly. This fact may be of considerable help in partially protecting sensitive components or systems by locating them at the greatest practical distance from the reactor.

(4) Local shielding. Additional reduction in the irradiation rate of a sensitive object can be obtained by providing it with special shielding. Design of such shielding and calculation of its effectiveness is beyond the scope of the present treatment.

(5) Rate of absorption. Of the irradiation received by a given material some may be transmitted through the material (as, for example, light through glass), some reflected, and the remainder absorbed. For given quantity and quality of irradiation the rate of absorption will depend entirely on the material. Absorption characteristics must be obtained either from individual test or from empirical equations based on the characteristics of a given class of materials (as plastics, elastomers, organics).

(6) Quantity. The final factor influencing energy absorption is obviously the time over which the radiation is received. With respect to time-integrated radiation absorption, inanimates are at a disadvantage as compared with humans because they do not have any mechanism (as does the human body) for partial or complete repair of limited damage.

12. HEALTH PHYSICS

In seeking to comprehend the magnitude of the health problem associated with a nuclear reactor it is helpful to note that there is many thousands of times more radioactivity associated with the used "fuel"—the ashes—of a reactor than with all the radium that has ever been mined. By careful safeguards a reactor can be prevented from constituting a health problem, but it is vital that everyone connected with nuclear engineering recognize the potential dangers. With recognition comes the understanding necessary for adequate protection.

Types of Radiation Sickness. The primary cause of damage to the human body from radiation is exactly the same as the cause of radiation damage to inanimate objects—ionization. Although there are some one hundred-million million atoms in a single body cell, the cell can be destroyed, as far as biological effectiveness is concerned, if only a relatively few atoms are affected.

Beta radiation has practically no biological effect due to the fact that electrons have very little penetrating power and are stopped by the outer layer of body cells; since the outer surface of the human skin consists entirely of dead cells, the only effect of beta irradiation is to produce a slight and transient heating effect.

Gamma rays—because of their greater penetrating power—are of greater biological significance. The gamma photons pierce the outer layers of body surface and produce secondary beta radiation deep within the body; the beta rays then cause excitation of orbital electrons or ionization in body tissue.

Neutrons are particularly dangerous to humans because a large part by weight of the body consists either of water or of other hydrocarbons. Recalling that a neutron is approximately of the same mass as a proton (a positive hydrogen ion) it follows that the very reasons which make hydrocarbons effective as reactor shields serve also to make the human body particularly susceptible to damage from neutrons. As a result of elastic collision between neutrons and hydrogen atoms, many hydrogen recoils occur with resultant disarrangement of body cell structure.

Aside from irradiation, biological damage also occurs as a result of ingestion (usually from breathing and drinking rather than from eating) of radioactive material. In this respect radioactive isotopes having a medium half life are far worse than either the short or long half lived ones. Those with short half life produce their effect rapidly and then are biologically ineffective. Those of long half life are very likely to be eliminated before they do substantial damage. But those of medium half life are active over a sufficiently long period to do substantial damage and to prevent normal cell repair.

In a broad sense damage to cells from radiation is of two types: single hit and multiple hit. Single hit damage occurs in cases where the body cells do not possess the ability to repair damage, hence are permanently destroyed if once "struck". This type of damage occurs in the brain, is responsible for gene mutation and is a definite cause of sterility (but not of impotence). Multiple hit damage occurs to those cells which do possess the ability to repair partially damaged cell sections. In this case a single hit might—in time—leave no effect, whereas repeated hits eventually lead to cell destruction. Multiple hit damage causes cancer of the blood, is responsible for increased viscosity of the protoplasm and, in consequence of general cell destruction, causes biological debris to enter the circulatory system and thereby affect the heart.

Again in a broad sense radiation sickness usually manifests itself in a sequence of four periods: (1) Nausea and a general feeling of lassitude, usually lasting a few weeks; (2) An unusual and deceptive sense of well being which succeeds the first phase and lasts for a brief period, often not more than a week or two; (3) A period of some weeks during which the victim is subject to loss of hair, constant diarrhea, bleeding of the gums, and other effects; (4) The last period is of the order of six months duration and in it the victim either undergoes slow convalescence or else becomes progressively worse and dies within this period.

Definitions of Special Terms. In the field of biological radiation damage the special conditions associated with living cells require the use of a number of specially defined terms. In succeeding paragraphs these terms will be explained and related to the basic unit or term for expressing radiation effect, the roentgen.

A roentgen is defined as that quantity of X- or gamma radiation which will produce, in one cubic centimeter of standard air, ions carrying a quantity of charge equal to one esu. This amount of energy is equivalent to 1 esu per 0.001293 grams of air and corresponds to an energy absorption of approximately 83 ergs per gram of air. In body tissue the absorption rate is somewhat higher than in air, so in such tissue (as in most inanimate organic matter) a roentgen corresponds to energy absorption at a rate of approximately 93 ergs per gram.

Since the roentgen was defined in terms of a specific type of radiation—X-rays—it is not directly applicable to other types. To overcome this difficulty a new term, the rep (roentgen equivalent physical) was defined. One rep has been recently standardized as that quantity of any type of ionizing radiation which will liberate 93 ergs per gram when absorbed in body tissue. (The rad, a unit of radiation amounting to 100 ergs per gram of material, is gradually becoming preferable to the rep.)

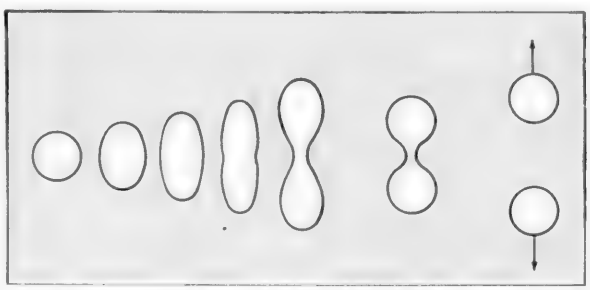


Fig. 22. The drop visualization of fission.

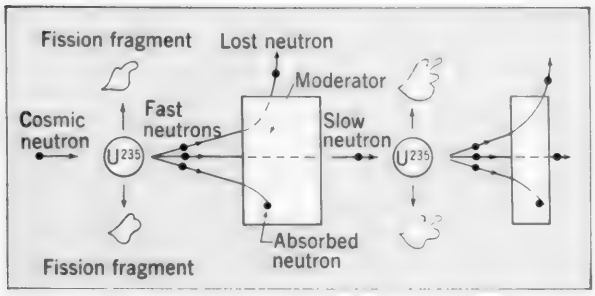


Fig. 23. Scheme of a chain reaction.

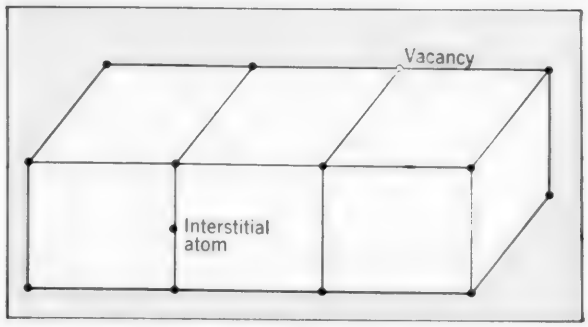


Fig. 24. Lattice damage due to radiation.

But for biological purposes it is desirable to compare cell damage rather than energy liberation. Thus it has been well established that protons and fast neutrons do far more damage to the human body, for the same energy release, than do gammas. The need, therefore, is for a term which will directly relate quantity of radiation to cell damage. Such a term, the roentgen equivalent man—rem—is one which gives that amount of *any* type of radiation which produces a biological effect equivalent to that due to absorption in body tissue of one rad of X-rays. Thus for X-rays one rem is equal to one rad and is slightly greater than one rep (since one rep releases 93 rather than 100 ergs per gram of tissue).

The roentgen, rep, and rem are units in which radiation rates are expressed, hence can have as many different values as there may be irradiation rates. To permit direct comparison of the biological effect of different types of radiation an additional term, the relative biological effectiveness—rbe—has been established. This term is a number equal to the ratio of physiological damage done by absorption in body tissue of a particular type of radiation to the damage that would be done by absorption in tissue an equal amount of energy of X-rays. For X-rays, beta rays, and gammas the value of the relative biological effectiveness is unity, but for neutrons, protons, or ingested alphas (that is, alphas released from ingested radioactive material) it is much greater. The following table permits comparison of roentgen (r), rep, rad, rem and rbe.

Comparison of Radiation
(values are approximate)

	Roentgen (r)	rep	rad	rem	rbe
X	1	1	1	1	1
Gamma	1	1	1	1	1
Alpha (internal)	–	1	1	20	20
Protons		1	1	10	10
Neutrons (fast)	–	1	1	10	10
Neutrons (thermal)	–	1	1	5	5
Beta		1	1	1	1

From the table it is evident that protons (hydrogen recoils) and fast neutrons are the most biologically hazardous of externally bombarding types of radiation. Note also that the correspondence between rem and rbe exists only in the table: Thus one might be irradiated by, for example, 173 rem of thermal neutrons, but the rbe of a thermal neutron would always be fixed at 5.

For biological purposes the influence of ingested radioactive material is not adequately expressed in terms of the half life. A half life was defined as that period of time in which the particular material loses one half of its initial (at the start of the selected time interval) activity. For health purposes the biological half life is defined as the time in which the body would dispose of, by all the normal processes of elimination, one half of any ingested material; thus, if the material were radioactive, its biological effectiveness would decrease as a result of both radioactive decay and bodily elimination. The effective half life obviously depends on both of these factors and is defined as the ratio of the product of radioactive and biological half lives to their sum. The effective half life is always somewhat shorter than either the radioactive or biological half lives.

In the literature on health physics the term rhm is sometimes used. This is a unit giving radiation in terms of roentgens per hour per meter; it was proposed by the U. S. Bureau of Standards, but has not gained wide acceptance.

For general measurements of radioactivity the basic unit is the curie, defined as that quantity of any radioactive material which would undergo 3.7×10^{10} disintegrations per second. A speck of iodine 131 would constitute a one curie source, whereas it would require over a ton of uranium 238 to do so. One curie of cobalt would provide 1.59 roentgen per hour (of gamma radiation) at a distance of one yard.

A unit proposed to replace the curie is a rutherford: one rutherford is defined as that quantity of radioactive material which will produce one million (10^6) disintegrations per second.

Tolerances. Based on a 1949 recommendation of the U. S. National Committee on Radiation Protection the tolerance dose or permissible dose of human absorption of radiation was established as 50 milliroentgens per day (or 0.3 r per week) for whole body exposure. The fluxes of various types of radiation corresponding to tolerance of 0.3 rem per week for a 5-day week at 24 hours per day are given by the U. S. Bureau of Standards as

Type of Radiation	*Flux*
Gammas, 1 Mev	1300 photons/cm²-sec
Electrons, 1 Mev	32 electrons/cm²-sec
Fast neutrons, 2 Mev	22 neutrons/cm²-sec
Thermal neutrons	600 neutrons/cm²-sec

This table represents the best available information, but it must still be regarded as tentative. Thus the neutron fluxes given in the table are in effect at Oak Ridge, but at Brookhaven the permitted value is only one third of this; the difference is indicative of the present uncer-

tainty concerning the accurate evaluation of the rbe of neutrons.

Tolerances for military personnel or for special purposes might be expected to differ from the values for civilians, but this subject has not been discussed in the unclassified literature.

The effects of acute doses of whole body radiation are approximately as follows:

0-25 r	No obvious injury
25-50 r	Possible blood changes, not serious
50-100 r	Probable blood changes; no disability
100-200 r	Injury; possible disability
200-400 r	Injury and disability certain; death probable
400 r	Fatal to 50%
Over 600 r	Fatal

The "medium lethal dose, LD-50" is 450 rem; this is the quantity of radiation which if received over the whole body would cause 50% fatalities within 60 days after exposure.

For local exposure the quantity of radiation which can be absorbed without damage is surprisingly greater than for whole body exposure. Thus a local dosage of over one thousand roentgen applied to the skin has an effect equivalent to that of a mild sunburn; in the treatment of certain diseases local doses of 10,000 roentgen are sometimes used.

Although exposure to radiation is usually thought of as a hazard associated with nuclear reactors, it is, in fact, a condition experienced by everyone at all times. The following table shows typical types of exposure.

External radiation of probable cosmic origin	0.0002 rem day
Internal radiation from radium in the body	0.0002 rem/day
External background radiation	0.001 rem/day
Atomic Energy Commission tolerance	0.1 rem day
Dental X-ray	5-50 rem
Local treatment of disease	3000-10000 rem

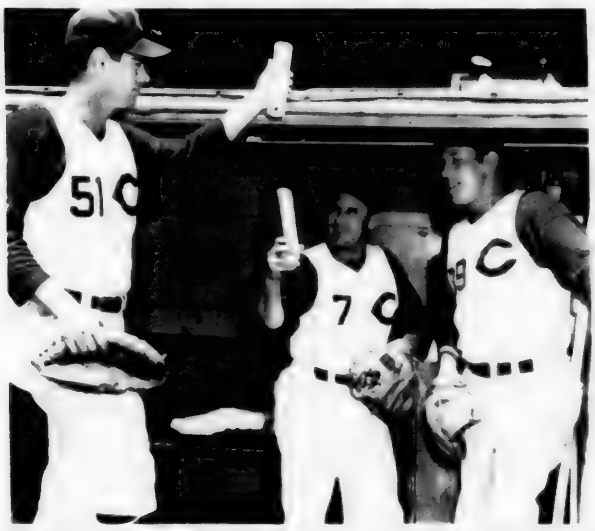
A watch with a luminous dial produces a skin dosage of approximately 100 milliroentgen per day which is practically equivalent to that of a chest X-ray.

Perhaps most surprising of all is the fact that an average adult has within his body enough radioactive potassium and radioactive carbon to produce internally an average of 250,000 beta particles per minute; thus radiation is a problem we all carry with us wherever we go.

Major Leagues Get Cooled Off

America's first professional baseball team and the first major league club to use lights, the Cincinnati Redlegs have air conditioned the dugouts for both the home and visiting teams. Also air conditioned are the press box, broadcasting booth, press room, and television monitor room.

Because mid-summer temperatures in Cincinnati are among the highest in the league, the Crosley Field dugouts had long been considered uncomfortable. Actually, this players' area was always considerably hotter than the stands because it is protected from the sun only by a low flat roof and enclosed on three sides preventing circulation of air.



Cincinnati catcher Forrest Burgess (center) and pitchers Art Fowler (left) and Joe Nuxhall compare the outside temperature with that in their newly air conditioned dugouts.

A tunnel-shaped room about six feet wide, six feet high and some forty feet long, the press box posed an unusual problem in air distribution. The designers solved it, however, by running a duct along the entire length of the press box roof and using eight semi-circular, ceiling diffusers through which the cool air is discharged into the box. No air from the booth is recirculated, the system drawing all fresh air into the coils.

A 5-hp air-cooled condensing unit in combination with a similar size coil and fan assembly were selected for the press box system.

The radio broadcasting booth, a cubical approximately six feet square alongside the press box, is cooled by a 1-hp, room air conditioner. Because the booth is open in front from about thirty inches above the floor, the unit is installed through the lower rear wall. Thus, the well is filled with conditioned air which spills up around the announcers and out through the opening in front.

Most challenging assignment faced by the engineers was that of comfort conditioning the dugouts. Redleg officials were concerned that there be no drafts which might chill overheated players coming in from the field, or cool off pitchers' arms.

It was finally agreed to install a system which encloses the dugout with a 36-ft curtain of cool dry air and effectively shields out the heat. Designed to reduce temperatures about 10 degrees, it discharges air from grilles along the length of the dugout ceiling. Players sit on a bench along the rear dugout wall, about four feet behind the air curtain where they are free from drafts.

A 5-hp, water-cooled condensing unit in combination with a coil and blower unit are used in the dugouts. The system, by Frigidaire, was designed by that company's engineers.

PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Heat Pumps Save Bank Money

PROBLEM: The First Federal Loan Association in Marion, Ind., was spending $900 a year to heat its building. In line with modern trends the bank management decided that air conditioning should also be installed. Estimators urged that the heating system be renovated in addition to the installation of air conditioning equipment.

SOLUTION: Two 5-ton heat pumps, manufactured by Westinghouse Electric Corp., were installed on the second floor of the 4400 square foot building. The units were designed to automatically heat, cool, dehumidify, and provide ventilation for the 39,460 cubic feet enclosed by the bank building. The units are capable of changing the air more than seven times an hour.

RESULTS: A saving of more than $3000 in installation costs over estimates for comparable equipment using conventional fuel sources were realized in addition to a saving of $200 for the year in operating costs despite the addition of air conditioning. Cost of operation is estimated at $700 a year. In addition to the saving in money, bank officials believe they are providing a cleaner and more healthful atmosphere for customers and employees.

Natural Ventilation Utilized to Aid Heating

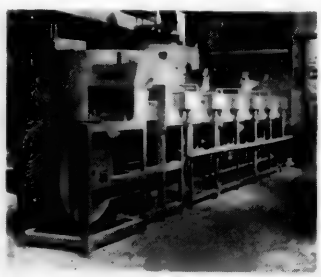
PROBLEM: The St. George's Episcopal Church, Hawthorne, Calif., built from a surplus army barrack shelter, 80 ft long by 20 ft wide, with a rotary roof vent at one end, numerous holes at the eave line, and without much protection from the elements, required heating. Economic considerations and space limitations restricted the type of equipment to gas space heaters.

SOLUTION: A downflow fan-type wall heater, Kilbury Floor-Flo, product of Kilbury Manufacturing Company, was installed free standing at the entrance end of the building, facing the altar and rotary vent at the farther end. In this way, the warm air leaving with discharge velocity at the bottom of the heater augments the natural ventilation flow towards the roof vent at the farther end, while a continuous supply of warm air at low levels offsets the development of cold air stratification on the floor.

RESULTS: The church remains comfortable at all times with the warmer conditions experienced at the end farthest from the heater. A heating paradox develops when late arrivals first enter the building, and finding it warm, leave the doors open to cool off the interior. Instead of cooling, the opposite effect or overheating develops, at least at the far end 80 ft away from the heater and entrance. The open doors permit a cold draft to enter which upsets the established temperature equilibrium in the building reached with closed doors, and the heater at the entrance responds with additional heat. Pressure differences drive the heat towards the extreme end and the net result is a local cooling effect near the front entrance and uncomfortably hot at the rear.

Regulator Maintains Furnace Temperatures

PROBLEM: How to eliminate fluctuating temperatures in the cooling chamber of a continuous atmosphere furnace was a problem confronting Lindberg Engineering Co., Chicago, Ill., a manufacturer of conveyor-type, continuous atmosphere furnaces for brazing, sintering, and annealing. Cooling is a critical part of the furnace operation. Metal parts emerge from the heating chamber at temperatures as high as 2050 deg F and must be cooled to 400 deg. Water-jacketed cooling chambers, made in 8-ft sections joined together, absorb and dissipate the heat. Previously, the company used an automatic solenoid control to open and close the flow of cold water in the water jacket. Because of the all-or-nothing response characteristic of the solenoid, water temperature varied widely from the desired 150 deg F. In turn, the atmosphere within the cooling chamber fluctuated, affecting the physical properties of the metal parts being cooled. For users of the furnace, this meant that precise duplication of brazing, sintering, and annealing procedures was difficult.



SOLUTION: In an effort to obtain better control of the cooling water temperature, the company's engineers replaced the solenoid control with a Powers No. 11, self-operating, temperature regulator. The liquid-filled bulb of the regulator was placed within each 8-ft water jacket section. The control valve was installed on the water line to the jacket and set at 150 deg.

RESULTS: The regulator did the trick. A temperature change at the bulb varies the pressure of the volatile liquid in the bulb. Pressure is transmitted through flexible tubing to the diaphragm bellows in the control, which operates the valve in a gradual manner. This regulates the flow of cold water into the jacket and holds the process under control at a constant temperature.

HEAT LOSSES FROM BARE TARNISHED COPPER TUBE

HORIZONTAL TUBES

Nominal Diameter of Tube, Inches	Temperature of Tube, Deg. F.										
	100	120	150	180	210	240	270	300	330	360	390
	Temperature Difference, Tube to Air, Deg. F.										
	30	50	80	110	140	170	200	230	260	290	320
	Heat Loss per Lineal Foot of Tube, Btu per Hr.										
¼	4	8	14	21	29	37	46	56	66	77	88
⅜	6	10	18	28	37	48	60	72	85	99	114
½	7	13	22	33	45	59	72	88	104	121	139
⅝	8	15	26	39	53	68	85	102	121	141	163
¾	9	17	30	45	61	79	97	117	139	162	187
1	11	21	37	55	75	97	120	146	173	201	232
1¼	14	25	45	66	90	117	145	175	207	242	279
1½	16	29	52	77	105	135	167	203	241	281	324
2	20	37	66	97	132	171	212	257	305	356	411
2½	24	44	78	117	160	206	255	310	367	429	496
3	28	51	92	136	186	240	297	360	428	501	578
3½	32	59	104	156	212	274	340	412	490	573	662
4	36	66	118	174	238	307	381	462	550	644	744
5	43	80	142	212	288	373	464	561	669	783	905
6	51	93	166	246	336	432	541	656	776	915	1059
8	66	120	215	317	435	562	699	848	1010	1184	1372
10	80	146	260	387	527	681	848	1031	1227	1442	1670
12	94	172	304	447	621	802	999	1214	1446	1699	1969

VERTICAL TUBES

Nominal Diameter of Tube, Inches	Temperature of Tube, Deg. F.										
	100	120	150	180	210	240	270	300	330	360	390
	Temperature Difference, Tube to Air, Deg. F.										
	30	50	80	110	140	170	200	230	260	290	320
	Heat Loss per Lineal Foot of Tube, Btu per Hr.										
¼	3	6	10	15	21	27	34	41	49	57	66
⅜	4	8	14	21	28	36	45	55	65	77	88
½	5	10	17	26	35	46	57	69	82	96	111
⅝	6	12	21	31	42	54	68	82	98	114	132
¾	7	14	24	36	49	64	79	96	114	134	155
1	10	18	31	46	63	82	102	123	147	172	198
1¼	12	21	38	57	77	100	125	151	180	210	243
1½	14	25	45	67	91	118	147	178	212	248	287
2	18	33	59	88	120	155	192	233	277	325	375
2½	22	41	73	109	148	191	238	288	343	402	464
3	27	49	87	129	176	227	283	343	408	478	552
3½	31	57	101	150	204	264	328	398	474	554	641
4	35	64	114	171	232	300	374	453	539	631	729
5	43	80	142	212	288	373	464	561	669	783	905
6	52	96	170	253	344	445	554	670	798	934	1080
8	69	127	226	337	458	592	737	892	1063	1244	1438
10	86	158	281	419	570	737	917	1110	1322	1548	1789
12	103	189	336	501	682	881	1097	1328	1582	1851	2140

HEAT LOSSES FROM BARE BRIGHT COPPER TUBE

HORIZONTAL TUBES

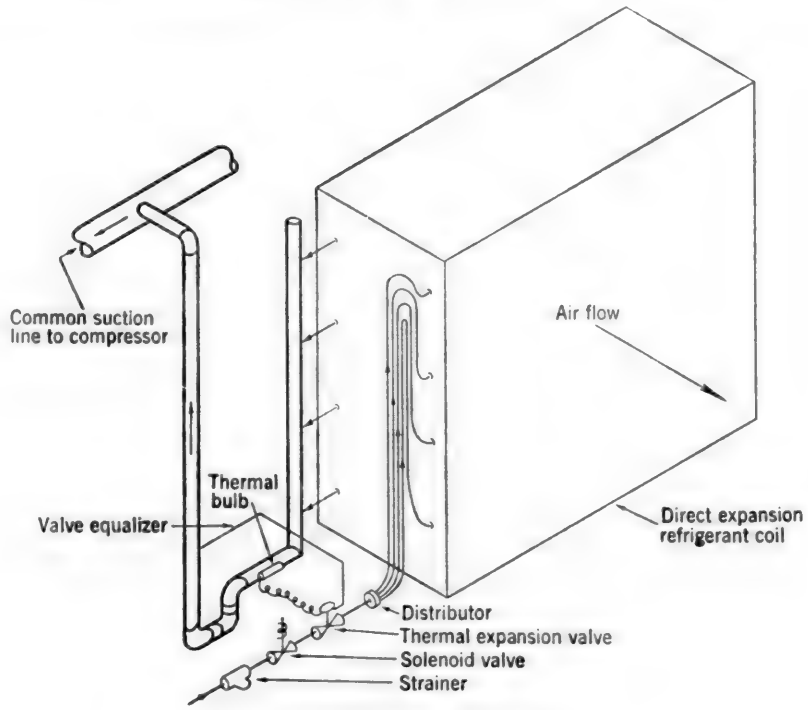
Nominal Diameter of Tube, Inches	Temperature of Tube, Deg. F.										
	100	120	150	180	210	240	270	300	330	360	390
	Temperature Difference, Tube to Air, Deg. F.										
	30	50	80	110	140	170	200	230	260	290	320
	Heat Loss per Lineal Foot of Tube, Btu per Hr.										
¼	3	6	11	16	22	28	34	40	47	54	61
⅜	4	8	13	20	27	35	43	51	60	69	78
½	5	9	16	24	33	42	51	61	72	82	94
⅝	6	10	19	28	38	49	60	71	83	95	108
¾	7	12	21	32	43	55	68	79	95	109	123
1	8	15	26	39	53	67	83	98	115	133	151
1¼	9	17	31	46	63	80	99	117	137	158	179
1½	10	20	36	53	72	92	113	135	158	181	206
2	13	25	44	66	90	115	141	168	196	226	257
2½	15	29	52	78	107	136	167	200	233	268	305
3	18	34	61	90	123	157	192	229	268	309	352
3½	20	38	68	102	139	178	218	260	305	351	400
4	23	43	77	113	154	198	243	289	339	391	445
5	27	51	91	137	185	237	292	347	407	469	533
6	31	59	106	157	213	270	336	400	464	541	616
8	40	75	134	198	271	347	426	507	594	686	790
10	47	89	159	239	323	413	509	607	710	822	935
12	54	104	184	276	377	482	593	707	827	957	1090

VERTICAL TUBES

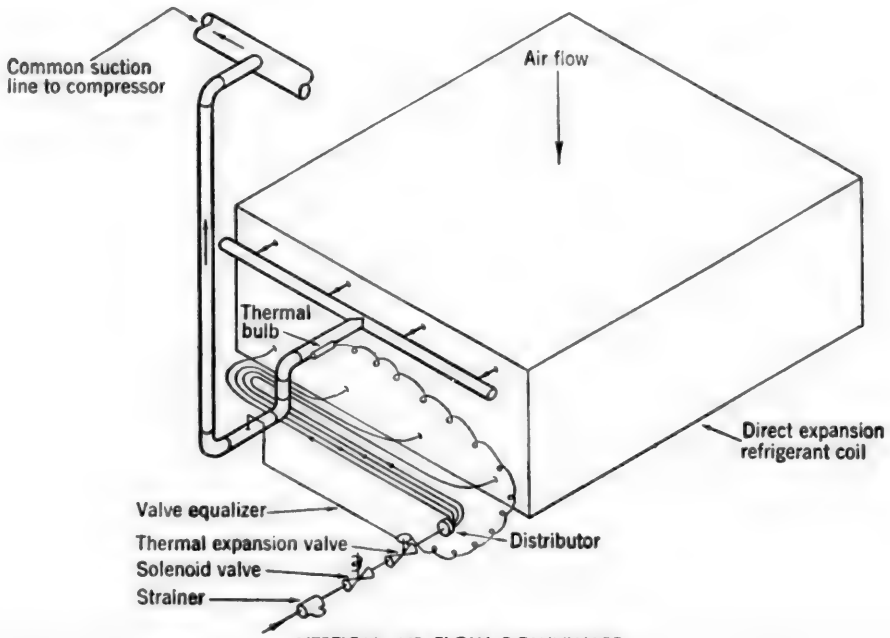
Nominal Diameter of Tube, Inches	Temperature of Tube, Deg. F.										
	100	120	150	180	210	240	270	300	330	360	390
	Temperature Difference, Tube to Air, Deg. F.										
	30	50	80	110	140	170	200	230	260	290	320
	Heat Loss per Lineal Foot of Tube, Btu per Hr.										
¼	2	4	7	10	14	17	21	25	30	34	39
⅜	3	5	9	13	18	23	28	34	40	46	52
½	3	6	11	17	23	29	36	43	50	57	65
⅝	4	7	13	20	27	35	43	51	60	69	78
¾	5	9	16	23	32	40	50	59	70	80	91
1	6	11	20	30	41	52	64	76	89	103	117
1¼	7	14	25	37	50	64	78	93	110	126	143
1½	9	16	29	43	59	75	92	110	129	149	169
2	11	21	38	57	77	98	121	144	169	195	221
2½	14	26	47	70	95	121	150	178	209	241	274
3	17	31	56	84	113	144	178	212	249	286	325
3½	19	36	65	97	131	167	206	246	289	332	377
4	22	41	74	110	149	191	235	280	329	378	429
5	27	51	92	137	185	237	291	348	408	469	533
6	32	61	110	163	221	282	348	415	487	560	636
8	43	81	146	217	294	376	463	553	648	746	847
10	54	101	182	271	366	468	576	687	806	928	1054
12	64	121	217	324	438	560	689	822	965	1110	1260

DIRECT EXPANSION REFRIGERANT COIL

Arrangements for Two Types of Air Flow

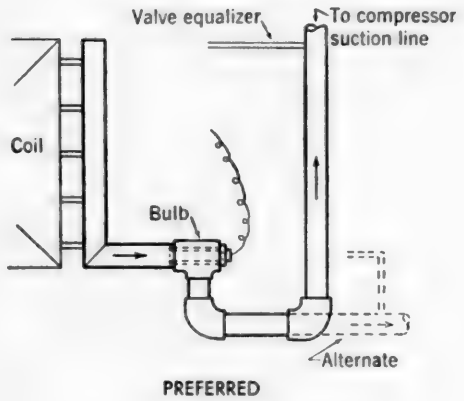


HORIZONTAL AIR FLOW



VERTICAL AIR FLOW DOWNWARD

EXPANSION VALVE BULB LOCATION



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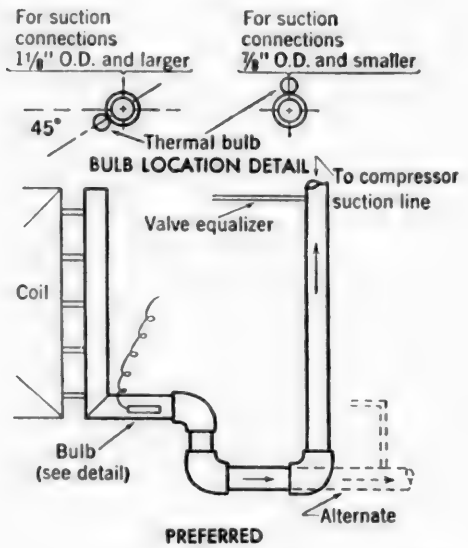

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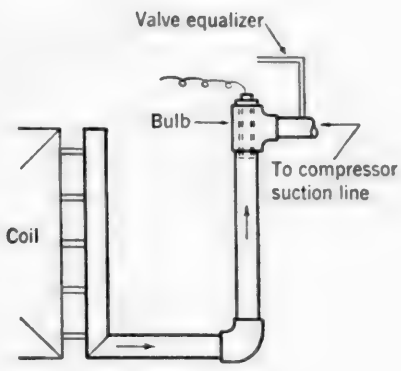
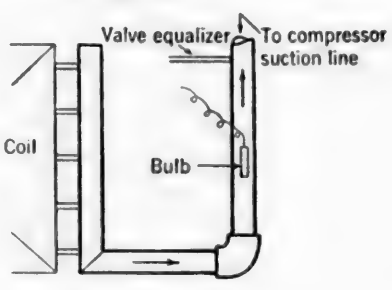
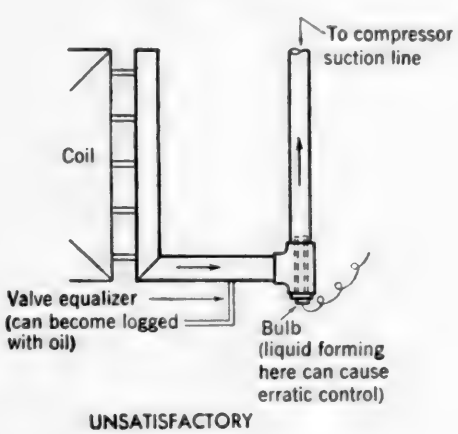


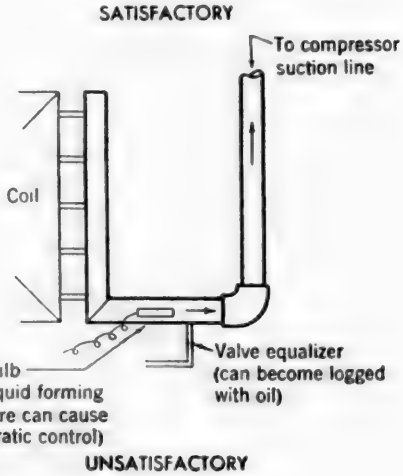
SATISFACTORY



SATISFACTORY


To compressor suction line
Coil
Valve equalizer (can become logged with oil)
Bulb (liquid forming here can cause erratic control)

UNSATISFACTORY


To compressor suction line
Coil
Bulb (liquid forming here can cause erratic control)
Valve equalizer (can become logged with oil)

UNSATISFACTORY

LOCATION OF INSERT TYPE THERMAL BULB. BULB IS INSERTED IN SEPARABLE WELL.

EXTERNAL THERMAL BULB LOCATIONS.

Drawings Presented through Cooperation of York Corp., York, Pa.

Below and on the following pages are given brief digests of the advertisements appearing in this month's issue. Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail the prepaid postcard to request further information from manufacturers.

The items appear in the same order as the advertisements to which they refer, to facilitate obtaining further information after reading an advertisement.

NOTE: All advertisements are digested here except those received too late for inclusion. The Index of Advertisers lists all the advertisements in this issue.

Use the postcard below for catalogs, new equipment and materials, as well as Ad-Digest items.

GAS-FIRED UNIT HEATERS. Inside front cover. Gas-fired unit heaters are made by this company in 7 sizes with input ratings from 25,000 to 200,000 Btu per hr. All parts are readily accessible for periodic servicing. The heater is designed for factories, repair shops, garages, warehouses, stores, and supermarkets. Information is available. ---------- **Item 148**

ROOF VENTILATORS. Page 1. Roof ventilators are offered by this company for any air or fume exhaust problem. Centrifugal and vertical discharge models are available as well as models for industrial air removal and hot, flammable, corrosive fume removal. Bulletins are available. ---------- **Item 149**

HEATING-COOLING UNITS. Page 2. Heating-cooling conditioners are offered by this company for hot water heating, chilled water air conditioning, and to provide a central system for both. Room units are available in free-standing, semi-recessed, or recessed cabinet types. Bulletin is available. ---------- **Item 150**

HEATING PUMP BULLETIN. Page 4. The answers to heating pump problems are offered by this manufacturer in its new pump bulletin. The company manufactures both single and duplex condensate pumps with mechanical shaft seals and a range of discharge pressures. Bulletin is available. ---------- **Item 151**

ROOF INSULATION. Page 7. Multiple aluminum is manufactured by this company in sections up to 750 ft. long for insulating roofs against radiation. The aluminum is almost impervious to water vapor and weighs but ¼ oz per sq ft. with a heat ray absorptivity and emissivity of 3%. Bureau of Standards booklet and sample are available. ---------- **Item 152**

WROUGHT IRON PIPE. Page 9. Wrought iron pipe's protection against corrosion is a concentration of thousands of glass-like iron silicate fibers distributed throughout the metal. As a result, deep pitting and penetration are repelled. A booklet is available. ---------- **Item 153**

FLUSH VALVES. Page 11. Nearly 350 of this company's diaphragm type flush valves were installed in a luxury dwelling overlooking Lake Michigan in Chicago. The valves were selected following competitive noise tests. A handbook and catalog is available with installation details for exposed, concealed, and special flush valve installations. ---------- **Item 154**

HEAT EXCHANGERS. Page 13. Heat exchangers with expanded heat transfer services are manufactured by this company for heating, cooling, process, and air conditioning. The exchangers are sold only by manufacturers of fan-system apparatus. A list is available. ---------- **Item 155**

Circle numbers corresponding to the items and advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.

CENTRIFUGAL COMPRESSORS. Pages 14-15. A new 500,000 sq ft factory building is completely air conditioned by this company's equipment. The system, with a capacity of 585,000 cfm, consists of 14 zones and is supplied with chilled water by three hermetically sealed compressors. Information on comfort and process air conditioning is available. ---------- **Item 156**

FANS. Page 16. Fans installed by this company in 1898 in a New England school have served continuously for 58 years. They are now being replaced due to remodeling, and a new unit is made by the company to extend the continuous service. Information is available. ... **Item 157**

COPPER TUBE. Pages 20-21. Copper tube in radiant heating systems does not rust, rot, or deteriorate; it requires fewer fittings; can be prefabricated in the shop; and is competitive in cost. Copper water tubes can be used for hot and cold water lines, air conditioning lines, waste lines, vent stacks, and underground service lines. Two 16-mm motion pictures are available for group showings.... **Item 158**

LINE OF PUMPS. Page 22. This line of five pumps consists of a sewage ejector type, a double suction horizontally split case pump, a condensation pump and receiver, flexible- or close-coupled pumps, and a condensation return pump and receiver. Bulletins describing each type pump are available. ---------- **Item 159**

AIR CLEANER. Page 23. The filter medium of these air cleaners carries a permanent, electrostatic charge that attracts and captures fine dirt particles. It also permits depth-loading and can be maintained by washing. The air cleaner can be used with any forced air heating or cooling system using panel filters. Details are available. ---------- **Item 160**

GAS-FIRED UNIT HEATERS. Page 24. Gas-fired unit heaters are made by this company with horizontal rear flue vent to allow greater installation flexibility and headroom. With either manual or automatic regulation, the heaters are offered in nine sizes from 25,000 to 225,000 Btu per hr. Oil-fired models also available. Information is available. ---------- **Item 161**

CONTROL SYSTEMS. Page 25. In Chicago's largest apartment building, the heating, ventilating, domestic hot water, fuel oil preheaters, and snow melting for walks and driveways are all thermostatically controlled by this company's regulators. The forced hot water heating system is regulated by an indoor-outdoor control system. Supply and exhaust fans are also controlled. Information is available. ---------- **Item 162**

IMPULSE STEAM TRAP. Page 27. A complete line of impulse steam traps in sizes and types for every requirement is offered by this company. The trap is good for all pressures without change of valve or seat; it has only one moving part, which is a small stainless steel valve that literally floats on the condensate load. A trap selector or 24-page bulletin is available. ---------- **Item 163**

INQUIRY CARD

Circle below item numbers on which you wish catalogs or further information.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138	139	140	141	142	143	144	145	146	147							
148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169
170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	192
193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214
215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233			

PLEASE PRINT Sept. H-56

This service available only to U. S. and Canadian readers.

Name ..... **Title** .....

Firm .....

Nature of Firm's Business .....

Street .....

City ..... **Zone** ..... **State** .....

This card is void after Dec. 1, 1956

Ad-Digest

TEMPERATURE REGULATORS. Page 30. When equipped with a metal seat and disc on steam service and protected by an approved strainer, this company's temperature regulator is guaranteed to shut tight when the demand for steam ceases. Temperature regulators are of the single seat design. Bulletin is available. ----**Item 164**

STEAM BOILERS. Page 31. Boilers manufactured by this company provide steam for air conditioning and heating a large office building. Boilers are available in standard sizes to 40,000 lb per hr of steam at pressures to 235 psi. Bulletin is available. ----------**Item 165**

DUST CONTROL. Page 32. Five tons of fly ash are trapped daily in a foundry by this company's filters and precipitators. The units require less space because each 20 x 20-in. cell has a rating of 3000 cfm. Bulletin is available. ----------**Item 166**

ANTI-CORROSION LININGS. Page 33. Linings of plastic, rubber, lead, copper, and cement are available from this company to solve corrosion problems in storing and processing water, acids, beverages, foods and most chemicals. The linings are available with the company's unfired pressure vessels. Reference catalog is available. ----------**Item 167**

FANS AND BLOWERS. Page 34. Fans and blowers are made by this company to power any ventilating system. Duct fans are available in sizes from 12 to 60 in., and bypass duct fans from 19 to 41 in. Vaneaxial blowers are available from 18 to 42 in. Bulletins are available. ------**Item 168**

AIR CONDITIONING CONTROLS. Page 35. The air conditioning system of a radio company's research building is controlled by a specially designed system of this company's thermostats, valves, dampers, and other apparatus. The company offers solutions to problems involving comfort control for the provision of protective temperatures and humidities for products and processes. Information is available. ----------**Item 169**

ROLL-TYPE AIR FILTER. Page 36. The air filter made by this company has a filtering material made of bonded glass fibers that compresses to paper-like thinness on a roll. The filter's media retains its jelly-like consistency under a range of temperature and humidity conditions. Bulletin is available. ----------**Item 170**

PIPE INSULATION. Page 37. One-piece molded pipe insulation is made by this company of fine glass fibers in sizes from ¾ to 33 in. IPS and in 3- and 6-ft sections. With just a pocket knife, the insulation can be fitted on bends, valves, and other fittings. An 8-page brochure is available. ----------**Item 171**

VALVES. Page 38. Since 1949, one of this company's valves has been on 10 to 15-psi steam service at 350 deg F in a sugar refinery. The valve is operated two or three times a week. The valve is a 12-in. iron body angle pattern. Information is available. ----------**Item 172**

AUTOMATIC CONTROLS. Page 39. How combined skills help to get best results with split-system heating and ventilating is described by this manufacturer. The combined efficiencies of electro-electronic control systems and proper air diffusion permit the maximum use of outdoor air for cooling in schoolroom ventilation. Information is available. ----------**Item 173**

STEEL PIPE. Page 40. The uniform ductility of this company's pipe permits better fitting to contours, no work slow downs, and no special equipment is needed. The pipe has uniform wall thickness and size and is uniform in strength and toughness. Information is available. ---------**Item 174**

UNIT HEATERS. Page 41. Unit heaters with a rectangular wrap-around heating element are made by this company to mount as close as 1 in. but not more than 3 in. from the ceiling. Thirty-four models are available with capacities ranging from 34,000 to 684,000 Btu per hr with a wide variety of outlets. Publication is available. ----------**Item 175**

MOTOR SERVICE. Page 42. Catastrophic or routine service on motors or generators is offered by this manufacturer from its more than 100 certified service shops. The shops have the manpower and equipment to perform repairs on any motor or generator of any make. The shops' locations in different areas are available.... **Item 176**

REGISTERS AND GRILLES. Page 43. A line of registers and grilles are made by this company for the control of warm air heating and for year-round heating and cooling. The line includes single damper forced air registers, ceiling air diffusers, perimeter baseboard diffusers and registers, and perimeter floor registers. A catalog of the complete line is available. ----------**Item 177**

UNIT HEATERS. Page 44. Horizontal unit heaters for steam and hot water service are available from this company in blow- and draw-through types in 36 capacities. Vertical unit heaters are offered in 26 different models, each with choice of four types of air deflectors. Bulletin is available. ----------**Item 178**

REFRIGERANT DISTRIBUTOR. Page 45. A one-piece refrigerant distributor is made by this company with a low pressure drop and a wide application range to replace distributors requiring as many as six or seven nozzles. The distributor functions in any position and can be used from 25% to 150% of rated capacity. Bulletin is available. ----------**Item 179**

STEAM TRAPS. Page 46. One of this company's steam traps has been operating for 47 years and is still operating. Float and thermostatic traps are made for low and medium pressure steam from 15 psi to 25 inches of vacuum in sizes from ¾ to 2 in. Bulletin is available. ----------**Item 180**

HEATING-COOLING EQUIPMENT. Page 47. A line of heating-cooling equipment is offered by this company including: water chillers; horizontal and vertical unit heaters; convector-radiators; and radiant and warm air baseboards. Information is available. ----------**Item 181**

ROOF EXHAUSTERS. Page 48. Roof exhausters are made by this company with U-spring suspension mountings that isolate the power assembly of the base of the unit to prevent vibration and noise. The motors are lubricated for ten years of continuous service. Information is available. ----------**Item 182**

MOTOR CONTROLS. Page 49. Motor controls made by this company have been standard on another manufacturer's ice machines for over 18 years. Solenoid starters have only one moving part and double break, silver alloy contacts. Thermal overload relays protect motors against burnout. Catalog is available. ---------**Item 183**

SOLDER-JOINT FITTINGS. Pages 50-51. Wrought solder-joint fittings and copper tube are manufactured by this company for refrigeration and air conditioning systems. The metal of the tube and fittings is identical. They fit each other and expand and contract as one unit. Copper tube is available in a range of sizes and fittings in many styles and sizes. Information is available. ----------**Item 184**

AIR FILTER LINE. Page 52. A line of air filters includes 1, 2 and 4 in. thick filters available in all sizes and most metals; a completely automatic filter that washes and re-oils itself in sizes to meet any cfm requirements; and a selection of grease eliminators. Catalog is available....**Item 185**

STEEL PIPE. Page 54. Over 7,000 ft. of ¾ in. steel pipe were used in the snow melting system, alone, of a new life insurance building. Steel pipe was also installed for the hot water heating system. Information is available ----------**Item 186**

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ELECTRIC MOTORS. Page 55. Electric motors are offered by this company with enclosed, fan-cooled type frames 184-256U. Due to greater mechanical and dielectric strength, insulating materials occupy less space. Bearings are available in several optional types. Bulletin is available. ----------**Item 187**

AIR CONDITIONING UNITS. Page 56. Air conditioning units with a muggy-air control are made by this company to take the chill and dampness out of cooling on muggy days without reheat or dampers. With two independent refrigerant circuits the upper circuit can be cut out to increase the dehumidifying effect by lowering the refrigerant temperature. Bulletin is available. ----------**Item 188**

MODERN COAL BURNING. Page 57. Up-to-date coal burning equipment can give 10 to 40% more steam per dollar. Automatic coal and ash handling systems can cut labor costs. No smoke or dust problems when coal is burned with modern equipment. Information and case histories of coal burning systems are available. ----------**Item 189**

AIR DIFFUSERS. Page 58. Slot air diffusers are slenderly designed by this company to be inconspicuously located in walls, ceilings, coves, moulds, window reveals and stools and almost anywhere to suit interior design. Air diffuser catalog is available. ----------**Item 190**

PIPING LAYOUTS. Page 59. How to plan piping connections for an all-year self-contained air conditioning unit is shown in a practical piping layout offered by this valve manufacturer. An enlarged diagram and full description of the layout is free on request. ----------**Item 191**

AIR-COOLED CONDENSERS. Page 60. A remote air-cooled condenser has been devised by this company for simpler multiple circuiting. The condenser's tubing assembly is self-reinforcing, locking out vibration before it starts. Bulletin is available. ----------**Item 192**

ELECTRIC MOTORS. Page 62. Every rotor used in this company's motors is dynamically balanced on balancing machines to operate smoothly and quietly. Totally-enclosed motors that are fully protected are offered in ratings to 500 hp. Information is available. ----------**Item 193**

AIR FILTERS. Page 63. Air filters are made by this company of soft glass fiber which provides a dust collecting area without interfering with air flow. They are moisture proof and fire resistant. The glass fiber filter does not splinter or shred. Information is available. ----------**Item 194**

AIR HANDLING EQUIPMENT. Page 64. A dual air conditioning setup that cools on the sunny side and heats on the shadow side of a Southern office building employs this company's air handling and conditioning equipment. The company offers equipment for large scale central or zone systems, or systems for smaller stores, show rooms and factories. Information is available. ----------**Item 195**

ROTARY OIL BURNER. Page 65. Rotary oil burners are manufactured for economical heavy oils by this company with a valve that will not pass the oil to the nozzle before it reaches a predetermined temperature. The burners are made in capacities from 8 to 200 gph. Literature and specification sheets are available. ----------**Item 196**

STEAM LINE INSULATION. Page 121. A Western Carolina college poured 74 tons of this company's insulation on a 1500-ft steam line installation. The insulation is poured on and tamped down; the pipe heat fuses it into three zones. Three types are available covering a temperature range from 220 to 520 deg F. Information is available. ----------**Item 197**

FAN VENTILATORS. Page 123. Fan ventilators are offered by this company with V-belt or direct drives for schools, hospitals, and public, commercial and industrial buildings. Certified capacities range from 408 to 36,430 cfm. Centrifugal wheels are backward curved blade in non-overloading design. Data book is available. **Item 198**

PIPE RACKING CHANNELS. Page 125. A method of pipe racking is offered by this company with six channels, clamps, hangers, concrete inserts, rollers, and other accessories. The method requires no drilling, welding, or riveting for supporting steam, gas, light conduit, air conditioning, or heavy water lines. A 78-page catalog is available. ----------**Item 199**

REVOLVING HEATERS. Page 127. Revolving unit heaters are made by this company for circulating heated air in slowly moving streams to keep room temperatures uniform. The heaters are made for medium and low ceiling heights as well as for high ceilings. Bulletin is available. ----------**Item 200**

SOUND TRAPS. Page 129. Sound traps are made by this company to silence air conditioning noise of all frequencies in the audio-frequency range. A 7-ft unit suppresses as much sound as 100 ft of ordinary duct lining. Four series cover applications ranging from offices to recording studios. Booklet is available...**Item 201**

AIR MIXERS AND DIFFUSERS. Page 131. An acoustically lined chamber made by this company blends the hot and cold air supplied to it at from 3500 to 6000 fpm. The air then passes through an air diffuser where it is mixed with room air to the desired temperature. A new products bulletin and selection manual are available. ----------**Item 202**

AIR RECOVERY. Page 133. A manufacturer of photosensitive aluminum plates for direct printing installed this company's air recovery unit to prevent the plates from becoming chemically fogged. Ventilating air is admitted only through the unit's activated carbon filters which extract gaseous contaminations. Assistance on air purifying problems is available. ----------**Item 203**

HEATERS-COOLERS. Page 133. The line of U-bend heaters and coolers made by this company includes: Tank suction heaters, oil pre-heaters, condensate coolers, storage water heaters, and instantaneous water heaters and convertors. Information is available. ----------**Item 204**

FLEXIBLE DUCT CONNECTORS. Page 135. Flexible duct connectors are made by this company in one-piece, factory-assembled, metal-to-material units that unroll flat. A choice of canvas, asbestos, and Neoprene-coated fiber glass is offered attached to galvanized steel or aluminum in 25, 50, or 100-ft rolls. Catalog and specification sheet are available. ----------**Item 205**

SECTIONAL CONDENSER. Page 135. The casing of this company's condenser is made of sections each separately removable to give access to all parts. The unit removes superheat before condensing and keeps the system purged of oil. Capacity range is from 90 to 240 tons. Bulletin is available. ----------**Item 206**

POWER BOILERS. Page 137. Power boilers are manufactured by this company to satisfy the demands of institutional, apartment, office and industrial buildings. The company also furnishes low pressure boilers for heating purposes. Information is available. ----------**Item 207**

ICE BANKS. Page 137. Sweet water ice banks are designed by this manufacturer to deliver tons of 32- to 34-deg F ice water for recirculation through air cooling coils in air conditioning systems. Designed for use with Freon, methyl chloride, or ammonia, the banks may be added to existing systems for increased capacity. Catalog is available. ----------**Item 208**

GLOBE VALVE AND UNION. Page 139. The bronze globe valve made by this company has a renewable composition disc, a two-piece union bonnet, and a radial seat. The union has a ground ball joint, two bronze seats, and a malleable iron body. Information is available. ----------**Item 209**

INQUIRY CARD

Circle below item numbers on which you wish catalogs or further information.

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Circle numbers corresponding to the items and advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.

Ad-Digest

ALUMINUM EXHAUSTERS. Page 139. A bulletin on spun aluminum exhausters is offered by this manufacturer with facts about centrifugal roof and wall mounted exhausters as well as axial flow units. Performance tabulation for both direct and V-belt driven roof exhausters are available throughout the range of sizes. ----------**Item 210**

AIR EXTRACTOR. Page 141. A scoop that diverts the air from the main duct to branch ducts or grilles is offered by this company to increase output to normal flow where needed. The curved steel blades of the extractor are adjustable and act in unison. A single key rod provides adjustment. Catalog is available. ------**Item 211**

UNIT AIR CONDITIONERS. Page 141. Unit air conditioners are furnished by this manufacturer in sizes of 3, 5, and 7½ hp. They have insulated cabinets; large cooling surfaces; insulated condensers; and conservative ratings. Bulletin is available. ----------**Item 212**

BOILER WATER LEVEL CONTROLS. Page 143. Boiler water level controls are equipped by this company with a permanent Alnico magnet, located outside the float chamber, to link water level and electrical controls. Units are available for temperatures to 750 deg F on pressures to 600 psi for single or multi-level stage control. Catalog section is available...**Item 213**

UNIT COOLERS. Page 143. Large capacity unit coolers are designed by this company to deliver full rated capacity in order to reduce the number of units required and eliminate extra piping and electrical connections. Units are made to operate at all normal temperatures. Information available. ----------**Item 214**

GAS OR OIL BURNERS. Page 143. These gas or oil burners combine low installation and maintenance costs with added years of dependable service. Information is available. ----------**Item 215**

DIRECT-FIRED HEATERS. Page 144. Stainless steel, direct-fired heaters are manufactured by this company in capacities from 300,000 to 2,000,000 Btu per hr output for industrial and commercial buildings as well as a number of special adaptations. Secondary heat transfer is provided with a multiple battery of 10-gage boiler tubes. Booklet is available. ----------**Item 216**

ELECTROSTATIC AIR FILTER. Page 145. The air filter offered by this manufacturer has a patented plastic mesh that attracts dust and dirt by electrostatic action, then quickly rinses clean. This feature results in fewer free service calls. Information is available. ----------**Item 217**

INTERIOR FIRE PROTECTION. Page 145. Contractors' success stories on interior fire protection jobs indicate there is a reason why this manufacturer's line of interior fire protection equipment is preferred. Check with the company's representative before figuring on the next interior fire protection job.----------**Item 218**

AIR DUCT HEATERS. Page 145. Controlled temperatures to 1000 deg F can be maintained by electric air duct heaters for heating air and gases under forced circulation. Installed in round or rectangular ducts, the heaters may be used for drying, curing, baking, and annealing ovens. Catalog is available. ----------**Item 219**

MULTI-FUNCTION CEILING. Page 146. A ceiling that provides radiant heating, cooling, ventilation, humidity control, noise reduction, and lighting from one integrated unit is offered by this manufacturer. A booklet containing photographs, details, and design data is offered. ----------**Item 220**

CAST IRON FITTINGS. Page 147. A cost comparison between cast iron screwed fittings and steel welded fittings is offered by this company covering 9 sizes each of 90-degree elbows, tees, reducing tees, and 6 sizes of eccentric reducers. A blotter showing the cost comparison is available. ----------**Item 221**

OIL-GAS BURNERS. Page 148. Dual fuel burners are manufactured by this company in sizes from 1 to 40 gph and in capacities from 100,000 to 5,400,000 Btu per hr. Automatic change-over can be accomplished by outdoor thermostat or any other suitable sensing switch. Descriptive circulars describing features and giving specifications are available. ------**Item 222**

STEAM TRAPS. Page 149. The steam traps offered by this manufacturer drain air out of cold unit heaters instantaneously, permitting them to give off heat in minutes. They also keep the heaters drained of condensate at all times. A booklet is available telling how to select and install traps for all steam equipment. ---------**Item 223**

PRESSURE CONTROLS. Page 150. Pressure controls are made by this company for fluids and gases with operating ranges from 0-14 to 0-300 psig. Controls for air or gas are available in six operating ranges from 0-0.1 in. pressure from 1-30 in. vacuum. Bulletin is available. ------**Item 224**

COOLING TOWERS. Page 151. A chemical company supplements its 1936 installation with a second cooling tower made by this company. A complete line of mechanical and natural draft cooling towers is offered by the company. Its engineers will assist customers in selecting the correct tower. Information is available. ---------**Item 225**

GAS UNIT HEATERS. Page 152. A gas-fired unit heater has been made stylish by this manufacturer with the use of polished chrome and a gray-green finish to enhance its modern lines. The heater is available in eight sizes from 25,000 to 310,000 Btu per hr, for natural, manufactured, mixed, LP and LP-air gas mixtures. Bulletin is available. ----------**Item 226**

VENTILATING SPECIALTIES. Page 153. The line of ventilating specialties offered by this company includes automatic shutters, back draft shutters, hand-operated shutters, automatic ceiling shutters, hand-operated ceiling shutters, and unit blower shutters. Circular and prices are available. ----------**Item 227**

HEATERS. Page 153. Direct fired, warm air heaters are made by this company in a full range of sizes for gas, oil, or gas-oil firing. A gas-fired, infra radiant heater is also made by the company for commercial and industrial heating. Bulletins are available. ----------**Item 228**

VENTILATORS. Page 153. The ventilators offered by this company have gone through several wind tunnel design stages to insure their performance under operational conditions. Engineering performance data on the line of ventilators are available. ----------**Item 229**

UNIT HEATER. Page 154. A unit heater for general purpose and heavy duty and industrial heating is available from this manufacturer in 24 sizes, 8 coil selections, 159 ratings from 100,000 to 2,500,000 Btu per hr, and capacities from 2000 to 25,000 cfm each. For general purposes, the heater has non-ferrous coils; for heavy duty work it has wrought iron coils. Booklet is available. ----------**Item 230**

AIR CONDITIONING EQUIPMENT. Page 155. One of seven complete lines of year-round air conditioning equipment offered by this manufacturer includes recessed room units and recessed console models. Literature is available. ----------**Item 231**

VALVE LINE. Inside back cover. A line of flow controlled valves includes packless and packed valves, strainers, dryers, check valves, relief valves, 3-way valves, liquid gage sets, flange unions, and accessories for air conditioning, refrigeration, and industrial users. A catalog describing the valves and two catalogs on ammonia valves and steel fittings are available. ----------**Item 232**

BOILER CONTROLS. Back Cover. Controls for boilers up to 250 psi are offered by this manufacturer in four models that meet all conditions. Two models are available with an adaptable water column form; the other two are made without the water column. Engineering folder and wiring sheets are available. ---------**Item 233**

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Architect's drawing of the United Services Automobile Association Building in San Antonio, Tex.

Air Conditioning System Designed for Flexibility

GERARD M. BAKER

Consulting Mechanical Engineer, San Antonio, Texas

The new home office building of the United Services Automobile Association in San Antonio, Texas, was built to meet the needs of a rapidly expanding company. Flexibility to meet present and future needs, therefore, was an important requirement of the air conditioning.

THE United Services Automobile Association is an automobile insurance firm specializing in insurance for commissioned officers in the U. S. armed forces. The new home office building of the Association, located on a main business artery leading into San Antonio, consists of an eight-story shaft approximately 108 by 242 ft surmounted by a two-story tower section 66 by 100 ft.

The eight lower floors of the building consist primarily of open office space, with the portion under the tower occupied by escalators, freight and passenger elevators, toilets and utility shafts. Extending to the south of the main shaft is a three-story wing approximately 100 by 192 ft housing a two-story cafeteria and personnel offices, with the kitchen, dead file room and maintenance shops located on the ground floor. The ninth or lower tower floor is occupied by the executive offices and board room, and the tenth or top floor is given over to a mechanical and fan room.

The building was planned for full owner occupancy, although one floor may be leased out on a short-term basis. Personnel of the company consists of about 25 men and 800 women, and it is anticipated that the number of women may be increased to 1200 in the future.

The company outgrew an older office building with an air conditioning system which, though fairly modern, gave rise to complaints of drafts, "dead" areas, poor temperature control and noise. The company's management, the architects and the present writer acting as consulting engineer devoted considerable effort toward eliminating the sources of these complaints in the air conditioning system for the new building.

The new system had also to be adapted to the requirements of the women who make up the majority of the employees, many of whom are executives of long tenure. In addition to eliminating the defects mentioned as associated with the system in the previous building, the system was also planned to meet the following needs:

(1) Complete flexibility of use. Due to rapidly expanding business, there is no assurance that any office area will remain in its original usage. This means that any given area may be used as a file room with low occupancy count, a general office area with closely spaced desks, a private office, or a machine room with a heavy cooling load from business machines. Since most of the space in the building can be easily converted from one type of oc-

The Anemostat octopus unit has a standard diffuser outlet for a ceiling diffuser. Input to the box is from a hot duct and a cold duct.

cupancy to another, it was essential that the flexibility of the air conditioning system match the architectural flexibility designed into the building.

(2) Flexibility of subdivision. Due to the above mentioned anticipated shifts in utilization of space, provisions had to be made for permitting subdivisions of the office space. Any perimeter bay might be divided into offices. Any interior bay may be divided into two, three or four offices by means of movable partitions located on column lines or bay center lines. This requirement, increasingly more common in rentable office spaces, places a heavy burden on the engineer in designing such flexibility into the air conditioning system.

(3) Flexibility of heat control. A further requirement dictated that any private office space partitioned off as anticipated must be equipped with individual temperature control to meet the requirements of the occupant of that space.

Structural Factors

The building was designed with a structural steel frame, with columns on 21 by 24 ft centers, a 13 ft typical floor-to-floor height and 9 ft ceilings. The steel cellular deck flooring and the steel beams and girders are fireproofed with a furred metal lath and lightweight plaster false ceiling. The clear space between the actual ceiling construction and the beam fireproofing is about 21 inches, with additional clearance provided under the decking but even less clearance under girders. Electrical raceways, a certain amount of plumbing and sprinkler piping and recessed fluorescent lighting fixtures all competed with the air conditioning ducts for available space.

Exterior columns in the main shaft were set back sufficiently to permit insulated 17-inch diameter maximum size vertical supply ducts to be placed between the columns and the aluminum and enamelled steel-faced exterior panels.

Air Conditioning System Design

Due principally to the relatively small space available in mechanical shafts and furred ceilings, and because fan rooms on the office floors were not desired, a double duct system of the high velocity and high pressure type was decided upon for the air distribution. The small size of ductwork required in the high velocity system made it possible to save considerable space. The original tentative layouts suggested zones for the four separate exposures, plus interior zoning, using single high velocity supply ducts and outlets coordinated with the tentative lighting layouts.

When these plans were discussed with the owners of the building, it developed that the single duct system, while adequate for many applications, did not provide the flexibility called for in the subdivided office areas. It was estimated that a dual duct system with complete localized controls would increase the cost of the system approximately 10% over the single duct system. It was therefore decided to remake the layout on the basis of a dual duct system to gain the added flexibility. (Actually, the 10% figure turned out to be too high. Although complete figures are not available, the additional cost probably did not exceed 6 or 7%).

In designing the system for the building, a number of basic decisions not usually required in more conventional systems had to be made. They included the following:

(1) Zoning. In changing from the original zoned single duct design to a double duct system, it was desired to retain the zoning by exposures. This was partly because the controls manufacturer acting as adviser strongly recommended zoning as a means of reducing control "hunting" and partly because the largest available high pressure fans could not supply more air than was required for any one zone. Accordingly, all exterior bays on the north side of the upper seven floors were included in one zone, and similarly the exterior bays with other exposures were zoned south, east and west. Supply fans serving these zones were located in the tenth floor fan room, with alternate hot and cold air supply ducts located at exterior columns. The interior bays were zoned half right and half left, with the fans supplying the upper four floors located in the tenth floor fan room and those supplying the interior zones on the lower floors located in the ground floor fan room.

A separately zoned high pressure system with its own fan room was provided for the cafeteria, and a number of both single and double duct high and standard pressure systems were provided for the maintenance and kitchen areas and for a small ground floor auditorium.

(2) Treatment of exterior bays. The exterior bays are 20 ft deep, and the exterior walls include continuous double-glazed openings extending from a 3 ft high sill to the ceiling line. To counteract the heat gain or loss through this glass, it seemed desirable that under-the-window supply units of some type be provided.

Extensive tests made by the laboratory staff of Anemostat Corp. under the direct observation of the author and including a full scale mock-up proved to his satisfaction that the use of under-the-window attenuation units with 100% aspiration, and supplied with the quantity and temperature of air set out in the design, gave very good air diffusion without drafts for the outer 17 ft of the 20 ft bay, overcame the hot glass effect and maintained acceptably low sound levels.

Due to the owner's requirement for future office subdivision, it was decided to use two under-the-window type attenuation units having 100% aspiration in each bay. These units and their supply ductwork are encased in plaster furring to the window sill line, topped with an

enamelled steel shelf or sill. To compensate for the slight lack of "throw" in the peripheral units, the ceiling diffusers in the adjoining interior bays will be adjusted to increase their throw slightly toward the exterior wall.

Each under-the-window unit is individually thermostatically controlled, with individual temperature selection.

(3) Treatment of interior bays. Laboratory tests on the full-size mock-up of an interior bay proved conclusively that the use of one attenuation unit in the center of each bay, with a ceiling diffuser having 100% aspiration, would be entirely satisfactory from every standpoint.

To provide for future subdivision of interior bays into office spaces, the attenuation units selected were of the Anemostat octopus type. That is, in addition to the regular bottom opening for the ceiling diffuser, there are four capped tabs at the sides of the box. Should a typical building bay require future subdivision, the standard ceiling diffuser will be removed and its opening in the attenuator box capped off. Flexible ducting will be attached to the side taps provided for this purpose and extended to a small attachment box complete with ceiling diffuser located in the center of each subdivided space. Up to four such diffusers may be fed from a single attenuator box, each diffuser being made the same size as the modular acoustic panels used as ceiling construction. Such changes as these may be made without shifting metal ductwork, and sufficient quantities of the flexible ducting, attachment boxes and ceiling diffusers were supplied to the owners of the building to take care of a considerable amount of relocating of outlets, work that can be done by the building maintenance crew.

Due to the fact that office subdivision will be more frequent in the exterior than in interior bays, the ceiling attenuation units are thermostatically controlled in groups of five or six, but provision is made for the future installation of individual control of each unit, whether it serves one bay or a small individual office unit.

Design Criteria

In sizing ducts, a maximum air velocity of 4,500 fpm was maintained and advantage was taken of static regain. Theoretical pressure drop in ducts was limited to 1 inch w.g. per 100 linear feet, but practically the drop was not this high. Maximum fan pressures did not exceed 5 inches w.g., which in light of present standards places the system in the category of a medium pressure rather than a high pressure installation, with high velocity distribution.

Cold air ducts were sized for 100% of the total air, and the corresponding warm air trunk ducts sized for 75% of total air. At the ends of runs, cold and hot ducts were sized the same to simplify the fabrication. To reduce duct sizes, cold air ducts are sized on the basis of a 30 deg F difference between the delivered air temperature and room design temperature. Accordingly, diffusers having 100% aspiration were selected to avoid a sensation of cold drafts and to provide more sensible air movement.

Return Air System and Power Plant

The owner's requirement for space subdivision dictated that the furred ceiling space be used as a return air plenum. Accordingly, a 12 by 12 ft return air register replaces one acoustic ceiling tile in each bay or enclosed office space. To equalize return air pickup as much as possible, a system of serpentine low-pressure return air ducts was provided in all furred ceiling spaces, with intake openings of graduated sizes provided at regular intervals in these ducts. The ceiling return ducts connect to vertical return air risers in the mechanical shafts, which connect back to the fan rooms. Steam for heating is supplied at 5 psi by two gas-fired low pressure steel boilers. Condensate return flows by gravity to a condensate storage tank, and from that point is then pumped back to the boilers.

Chilled water is provided by three 350-ton centrifugal water chillers located in the sub-basement. An induced draft, double flow cooling tower is located at grade in the parking lot, several hundred feet distant from the building. Chilled water off the chillers is circulated in a pipe loop located at the machine room ceiling, with provision being made to operate either one, two or three chillers depending on the load. Off of the loop are taken five separate pumped chilled water circuits to serve the various groups of fan and coil units. Thus the chilled water circulated to any part of the building can be cut off in the machine room, should cooling not be required.

In addition to the fan room on the tenth floor, there is a fan room 42 by 98 ft on the ground floor directly under the utility portion of the office floors, and this extends one floor deeper to form a basement mechanical room. A short tunnel connects this mechanical room with an underground fan room housing fresh air intake and exhaust fans. Areaways with gratings flush with the lawn serve as air intakes and exhausts for this fan room. At either end of the mechanical room is a vertical shaft connecting the ground and ninth floor fan rooms.

Return air from each zone is filtered in the fan room and combined with fresh air make-up which has also been filtered and cooled or heated to approximately return air temperature. It is then drawn from the mixing plenums by the high pressure fans and blown through a pair of hot and cold coils located side by side. The double duct distribution system starts at the leaving side of the coils.

Installation

No major changes were made from the contract drawings in the contractor's drawings, but a few minor and at times troublesome relocations had to be worked out on the job. The worst spots were at the mechanical shafts, where there is the greatest accumulation of supply and return duct take-offs, bus ducts, piping, escalator machinery and other equipment. The crowded condition was aggravated by the requirement that branch supply duct take-offs must be made with long sweep ells, which require much more room than the right angle take-offs in low pressure work. The liberal use of flexible ducting in sizes 12 inches and under helped in avoiding interferences, but in several cases the corridor and toilet room ceilings were lowered slightly to provide for concealment of mechanical work.

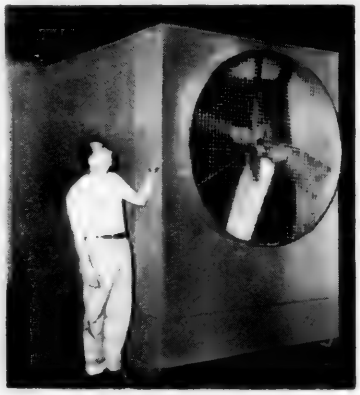
This installation is an indication of the flexibility that can be achieved in an air conditioning system with the advanced equipment now available and modern principles of design. The use of dual duct air distribution provides the flexibility for future changes in the use of space and is particularly adaptable to office buildings such as the USAA Building.

NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid postcard appearing on page 101 for securing additional information on new equipment and materials described in this department.

Large Tower Is Added to Line

The size range of its cooling towers has been extended by Halstead & Mitchell, Pittsburgh, Pa., to include 75-ton units.



Like all of the company's cooling towers, the new 75-ton units will be covered by a 20-year guarantee on the wetted deck surface against attack by rotting or fungus growth. The wetted deck wood is pressure creosoted.

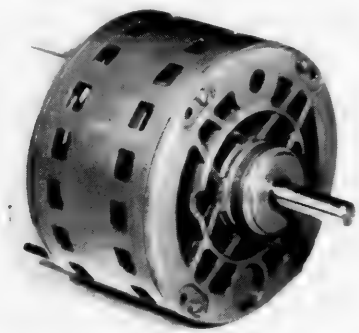
The 75-ton cooling tower makes use of a 4-blade, slow speed fan, which is zinc-plated and chromate-dipped. The fan shafts are made of stainless steel. Vinsynite, vinyl zinc and chlorinated rubber paints are hydraulically applied to the steel cabinet to eliminate rust.

More information? Circle Item 1 on postcard, page 101.

Motor Reverses at High Speeds

A shaded-pole motor that reverses positively at high speeds without a capacitor and with low reversing current has been developed for window fan applications by General Electric Co., Schenectady, N. Y.

Available in 1/15- through ⅛-hp ratings with single and dual speeds, the 5½-in. diameter motor is suitable for use in window ventilators, evaporative coolers, exhaust and circulating fans, and similar air moving devices with moderate radial and axial thrust loads.



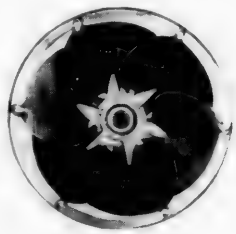
The switch control makes it unnecessary to halt the fan motor to reverse direction at high speed. The ⅛-hp size, with an efficient blade, can deliver in excess of 3500 cfm.

Designated KSR39, the motor is manufactured in the 1/15- to ⅛-hp in 6-pole, 1050-rpm ratings. Weighing between 9 and 10 lb, depending upon the rating, the motor can be mounted with through-bolts to a shaft-end or opposite shaft-end connection. Other types of mountings are also available.

More information? Circle Item 2 on postcard, page 101.

Fans Have Slinger Rings

A line of 6-blade propeller fans, in diameters from 8- to 30-in., has been developed by Brookside Products Co., Inc., McCordsville, Ind.



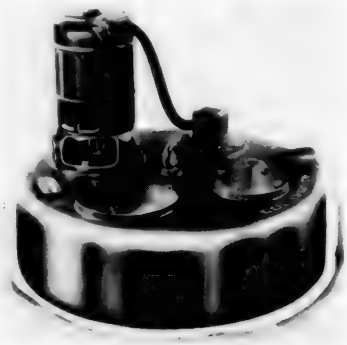
The fans feature reduced depth requirements, solid slinger rings, and slinger ring tabs that are integral parts of the blade members. They are suitable for the thin line air condition units. Available with or without slinger rings, the fans may be made with practically any axial depth desired. They are also available with solid or rubber bushed hubs.

More information? Circe Item 3 on postcard, page 101.

Low Pressure Condensate Pump

A low pressure system condensate pump, with a 25-gal cast iron receiver, is announced by Weil Pump Co., Chicago, Ill.

Made of bronze, the pump has a stainless shaft and is equipped with 1750-rpm motors in sizes from ½ to 1 hp. The pump itself has a capacity range to 20,000 sq ft EDR at pressures up to 40 psi.



Installation of the pump requires only two connections: the return and the discharge. The centerline of the 3-in. return is 10½ in. from the floor. The receiver is 25 in. OD. and the over-all height of the unit is 36 in.

The same cast iron receiver is used for both single and double pumps. This permits simplex units to be converted to duplex units at any time.

More information? Circle Item 4 on postcard, page 101.

Multi-Valve Water Softener

A multi-valve water softener is being produced in four sizes by The Duro Co., Dayton, Ohio.

The softeners are being offered in capacities ranging from 15,000 grain gallons (Model MV-15) to 60,000 grain gallons (Model MV-60). Other models are MV-30 and MV-45.

In addition to removing hardness, the softeners remove iron in solution up to 10 parts per million. The largest unit is 60 in. high, 17 in. wide, and 13 in. deep. Its shipping weight is 238 lb. The smallest softener is 47 in. high, 13 in. wide, 9 in. deep, and has a shipping weight of 91 lb.

The units are built of heavy gage steel tanks, galvanized inside and out. The finish is baked-on, refrigerator-type, white enamel. They have removable lids for the introduction of salt and brass valves for reconditioning. All fittings are $1\frac{1}{2}$ in.

More information? Circle Item 5 on postcard, page 101.

Controllers for Batch Processes

Two non-indicating controllers are available from Wheelco Instruments Div., Barber-Colman Co., Rockford, Ill.

Designated the 150 Series, the controllers are potentiometer type units designed for control applications encountered in batch process work. They employ a circuit in which the unknown voltage is connected in opposition to a known voltage with any difference used to actuate the control circuit. A sensing element supplies the unknown voltage in the circuit.

The Model 151 Amplitrol is a simple on-off controller for those applications where transfer lag and dead time can be reduced to a negligible value and the simplest of control forms made usable.

The Model 152 is an anticipatory time-proportioning controller which compensates for system inertia. A time-constant network within this controller causes a control device to go to the *off* position slightly before the normal *off* point is reached; likewise, the *on* cycle starts slightly ahead of the normal controller *on* point. The anticipatory action starts as soon as the controlled temperature comes within the proportioning band of the instrument, i.e., 1% of scale range to either side of the control point.

The contact rating of the control is 6 amp at 115v a-c, and 3 amp at 230v a-c. The sensitivity of the instrument is 75 microvolts for all scale spans. The fixed cycle time of the Model 152 is approximately eighteen seconds.

The overall dimensions of the controllers are $7\frac{5}{8}$ in. wide, 7 25/32 in. deep, and $8\frac{1}{8}$ in. high. The weight is approximately seven pounds.

More information? Circle Item 6 on postcard, page 101.

Combustion Chambers

Combustion chambers tradenamed Jet-line are being manufactured by Grant Wilson, Inc., Chicago, Ill.

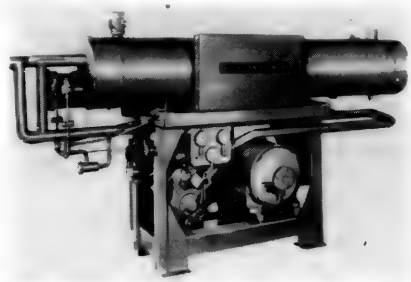
A range of fifteen sizes from 0.6 to 12.0 gph is offered by the company in both a pear shape and the conventional round shape. The refractory is pre-cast.

More information? Circle Item 7 on postcard, page 101.

Packaged Water Chillers

A line of packaged and tested water chillers for air conditioning or industrial cooling applications is available from American Blower Corp., Detroit, Mich.

Designated as Type CC, the chillers are available in capacities from 20 to 150 tons. Each unit consists of a base and framework, a reciprocating type Freon-22 compressor, a direct-expansion chiller section, heat exchangers, a control panel, an electric drive motor, and associated valves, strainers and gages. Across-the-line magnetic motor starters are standard equipment.



A major component in the chillers is a new copper tubing with a star-shaped aluminum insert. This new tubing has more than double the heat-transfer surface of plain tubing and adds 25% more cooling capacity per cubic foot of chiller size.

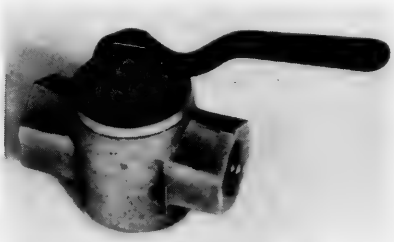
The chiller element has a shell of seamless steel tubing. The tubes are $\frac{3}{4}$-in. OD seamless copper and are roller-expanded into the tube sheets. Water connections 3-in. and smaller are heavy pipe couplings. Connections larger than 3-in. terminate in 150-lb ASA steel flanges with a threaded cast-iron companion flange.

Design working pressure for the tube side is 235 psig; for the shell side, 150 psig. Test pressures are 300 psig for the tube side, 300 psig for the shell side. Tubes, shell, heads and tube sheets are fabricated of materials which meet ASME specifications. Refrigerant head gaskets are die-cut out of medium-density Neoprene. Water baffles are fabricated of zinc-plated, hot-rolled steel. Brass baffles for special applications are available as an option.

More information? Circle Item 8 on postcard, page 101.

Valve Has Plastic Seal

A valve which employs a newly developed plastic seal is made by U. S. Valve Corp., Elizabeth, N. J. It is suitable for the control of fluids, such as water, oil, or gasoline, and gases, such as acetylene, propane, butane, or coal gases.



The gate of the valve has a straight cylindrical hole which, when the valve is opened, is in line with the opening in the valve body. There is no restriction to the movement of the flowing fluid or gas. A one-quarter turn is all that is necessary to open or close the valve.

The valve has a working pressure of up to 435 psi and can be tested at pressures of up to 725 psi. It is designed to operate at temperatures up to 250 deg F. The plastic seal has a shore hardness of 80.

More information? Circle Item 9 on postcard, page 101.

Cast Iron Boiler Series

A series of oil-fired, cast iron boilers for small and medium-size residential installations as well as small commercial applications is announced by Thatcher Furnace Co., Garwood, N. J.

Patterned after the company's Oilmaster boiler, the new line is known as the Oilmaster 56 Series. It is suitable for contractors serving both the new building and home modernization markets.

The boilers have sealed tongue and groove joints, five-way fire travel, and extended fins. To lend a modern touch to the unit's appearance, an extended casing to conceal the oil burner is offered as optional equipment.

The line is comprised of six units, three each for steam and water. Their gross IBR output ratings range from 97,000 to 168,000 Btu per hr.

More information? Circle Item 10 on postcard, page 101.

Baseboard Heating Accessories

Two steps to facilitate the installation of radiant baseboard heating systems have been taken by Crane Co., Chicago, Ill.

The first step is the introduction of a line of steel accessories for radiant baseboard. The second step is the publication of a booklet telling how to install baseboards.

The baseboard accessories, all die-formed from furniture steel, include a new unit: the outside corner. Also carried in the line are steel extension panels, inside corners, right and left hand end caps, and junction plates.

For use with either Type R or Type RC baseboards, the accessories slide into position, where they are held permanently in place by positive spring clips. The accessories permit the installation of radiant baseboards in most buildings having irregular floor plans—buildings where such installations were previously limited.

The baseboard installation booklet contains fourteen pages of step-by-step instructions, illustrated by photographs. The booklet shows how to assemble sections of baseboard and how to install them—Type RC radiant convector baseboard at the floor, and Type R radiant baseboard at both floor and ceiling. Also described is the use of each item in the line of steel baseboard accessories.

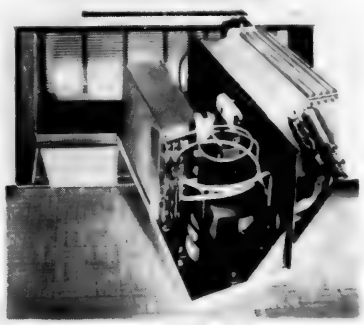
More information? Circle Item 11 on postcard, page 101.

Self-Contained Air Conditioner

A self-contained room air conditioning unit for multiroom buildings is announced by Plumbing and Heating Div., American Radiator & Standard Sanitary Corp., New York, N. Y.

Known as Model SR Remotaire, the air conditioner is a wall-hung room unit with an outside grille. It is designed for air conditioning hotels, office buildings and apartments with individual room control.

Cooling is supplied by a self-contained, air-cooled refrigeration circuit in each unit. An integral air-cooled



condenser eliminates the need for water piping connections for the cooling circuit.

Heating is supplied by a steam or hot water coil in the unit which can be connected easily to the central heating system. Conditioned air is circulated throughout the room by low-speed centrifugal blowers contained in the unit. The amount of heating and cooling can be controlled manually or automatically within the room.

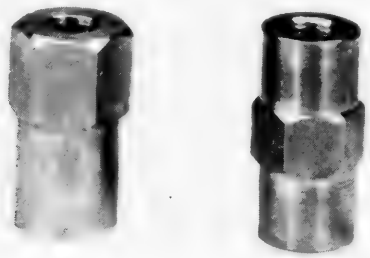
The air conditioner contains a sleeve, faced with an outside grille, which can be installed on the outside wall of the room. The grille is set flush with the outside wall, leaving no overhang to mar the face of the building.

Because it is wall-hung, the unit provides a bottom kick-space on the room side, which means that carpets need not be cut on modernization jobs. The room air intake with filters is at the bottom of the unit. The cabinet projects slightly more than 10 in. into the room when installed in a standard 12-in. wall. The overall height is 21½ in., with the supply grille located on the top.

More information? Circlel tem 12 on postcard, page 101.

Oil Burner Nozzle Adapter

An oil burner nozzle adapter made from steel has been developed by The Chicago Screw Co., a division of Standard Screw Co., Bellwood, Ill.



Available in a variety of dimensions, the adapter has its nozzle end tapped 9/16 in. to fit the standard nozzle; the oil line end is tapped 1/8 in. pipe for a standard fitting. The adapter is furnished with 11/16-in. hexagon around the center or with a 3/4-in. hex on the end.

All the adapters are available from stock, and parts with a 1/4-in. pipe are available on special request.

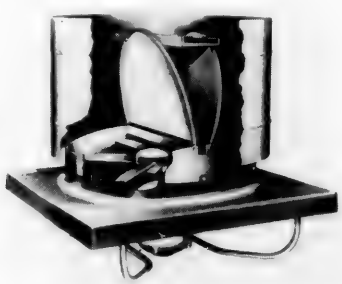
The strength of the steel threads allows the nozzle to be pulled down more tightly and affords less possibility of leakage. The adapter has been approved by Underwriters' Laboratories.

More information? Circle Item 13 on postcard, page 101.

Ventilator Has Damper Opener

An industrial roof ventilator with an emergency damper opener is offered by Detroit Blower Co., Chicago, Ill.

Named Jet Axial, the ventilators can be furnished with a fusible link device which acts as an emergency damper opener during fires.



Normally, the fusible link keeps the dampers closed by spring tension when the ventilator is not in use. Exposed to intense heat, the link breaks allowing the dampers to open and smoke and heat to escape. The device is independent of the fan's operation. The spring itself is shielded from flames by the damper blades to prevent annealing and loss of tension from the heat.

Among the major operating features of the steel-fabricated roof exhauster are butterfly dampers that open automatically during fan operation but seal the ventilator when not in use. During fan operation, exhaust air is dissipated with sufficient velocity to exclude rain or snow and prevent exhaust from re-entering.

Eight different size roof ventilator packages are currently available. Blade diameters run from 24 to 60 in. The varied motor outputs offer an exhaust range from 6640 to 53,700 cfm.

More information? Circle Item 14 on postcard, page 101.

Magnets Prevent Scale

A magnetic device for preventing and removing scale formations from pipelines is introduced by Cepi-American, Oak Park, Ill.

Known as Cepi-Comav, the device operates on a principle that consists in passing the water through magnetic fields, as a result of which the dissolved salts undergo a physical change and are prevented from coagulating and depositing as hard scale.

The device itself is a cylindrical tube with ordinary threaded connections on the small and medium sized units or with standard flanges on the larger sizes. Inside is a series of permanent magnets arranged so that the liquid passes through a succession of alternate magnetic fields, at right angles to the lines of force, thus insuring maximum inductive effect.

In steam plants the salts precipitate as a fine sludge which is removed by blowing down, but where water is only heated to a temperature below 160 deg F as in calorifiers and condensers, the salts remain in suspension and are carried through in the water.

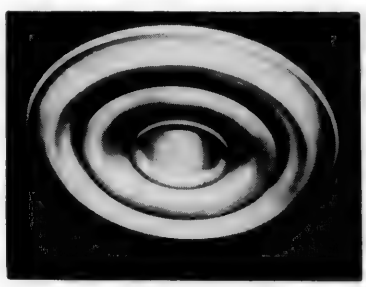
Units are available in sizes to handle flow rates from 2 to 15,840 gpm and in lengths from 6 11/16 to 78 3/4 in.

More information? Circle Item 15 on postcard, page 101.

Adjustable Ceiling Diffuser

An economy model ceiling diffuser, which is adjustable on the job, is announced by The Titus Mfg. Corp., Waterloo, Iowa.

Called the Model T-1, the three-cone diffuser is an addition to the company's line of ceiling diffusers and accessories.



A spring lock arrangement permits the removal or installation of the inner cone assembly. It is adjustable—on the job—to two different air patterns by changing screws on the inner cone assembly.

A heavy-duty sponge gasket around the outer edge of the diffuser assures an airtight installation.

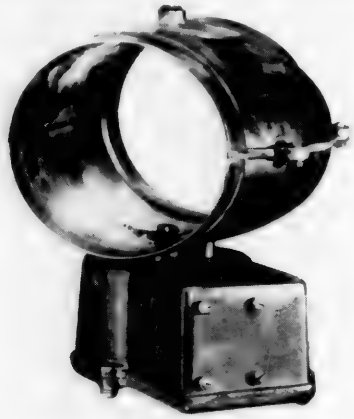
For exposed duct or flush mounting, the diffuser is available in all standard sizes with a line of accessories. Each diffuser is individually packaged.

More information? Circle Item 16 on postcard, page 101.

Air Control Valve

An air control valve for increasing the efficiency of air suction systems and dust collectors has been improved by The Kindt-Collins Co., Cleveland, Ohio.

Known as Ventomatic, the valve is used on metal grinding and polishing machines, wood joiners, sanders, table and band saws, and other machines producing dust,



shavings, or lint. The use of the valve improves the efficiency of existing dust-collecting systems that are presently overloaded.

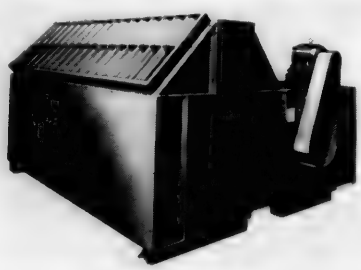
The valve's features are that it operates automatically, concentrating the suction of the collector, only at the machines in operation, and it presents an unobstructed passage for the air stream when open, thereby eliminating clogging.

The air control valve may be installed in any position. It is available in 110, 220, and 440-V. models and is designed to accommodate 3- to 8-in. openings.

More information? Circle Item 17 on postcard, page 101.

Multi-Zone Air Conditioners

An air conditioning unit for buildings where one or more zones call for maximum cooling while other zones require lesser degrees of cooling, and still others, heating, has been redesigned by The Trane Co., La Crosse, Wis.



Called the Multi-Zone Climate Changer, the unit is made to supply any combination desired: complete air conditioning, cooling only, heating only, cooling and ventilating, heating and ventilating, heating and humidification, or ventilating only. It can furnish conditioned air for up to as many as twenty-five zones, at temperatures which can be varied to the requirement of each zone.

Available in nine sizes with capacities ranging from 1700 to 29,000 cfm of air, the unit will supply year-around air conditioning for a medium size building. The unit can use any type of cooling and heating coil including chilled water, direct expansion refrigerant, or steam or hot water.

In addition to the coils, other matched components include a new damper section arrangement, low velocity unit fans, a humidifier (three types available), high or low velocity filters, and a mixing box as specified. Bulletin DS-303M gives information on these and other features of the units.

More information? Circle Item 18 on postcard, page 101.

Continuous Convector-Radiator

A continuous convector-radiator, called CTS, is added to the heating line of Fedders-Quigan Corp., Trenton, N. J.

Although new, the unit has been field tested. It provides up to 3930 Btu per hr per lineal foot and is designed to accommodate a long wall with a minimum of piping and connections.

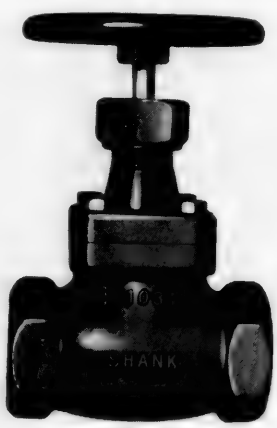
The specifications of the unit include: element tubes expanded to fit over adjoining sections for sweat connections; ribbed aluminum fins spaced by die-formed collars to increase the metal-to-metal contact between fin and $\frac{3}{4}$-in. copper element tubes; and interlocking fronts for adjacent sections to present a smooth assembled appearance without the necessity of joining strips.

The standard model is available in 18-gage top and front with 16- and 14-gage available for heavy duty. It comes in three basic heights, 4 or 6 in. deep and in any length from 16 in. to 5 ft 4 in.

More information? Circle Item 19 on postcard, page 101.

Bolted Bonnet Shutoff Valve

A heavy duty, bolted bonnet type of shutoff valve, provided with back seating for repacking under pressure is announced by Cyrus Shank Co., Chicago, Ill.



Among the new features incorporated in the valve is a swivel and self-aligning seat of soft metal alloy.

The valve is available in both globe and angle types for pipe sizes $1\frac{1}{4}$, $1\frac{1}{2}$, 2, and $2\frac{1}{2}$-in.

More information? Circle Item 20 on postcard, page 101.

Hi-Fi Heating System

A central entertainment system that feeds sound from a record player, television or radio set into the warm air heating system is announced by Alsto Co., Cleveland, Ohio.

Called Registered Music, the system provides background music for every room in the house. It consists of running a wire from the existing location of a record player, television or radio set to a speaker attached to the plenum chamber or dome of any warm air heating system or to air conditioning ducts. The speaker sends the sound into the warm air heating system and out through the warm air registers throughout the house.

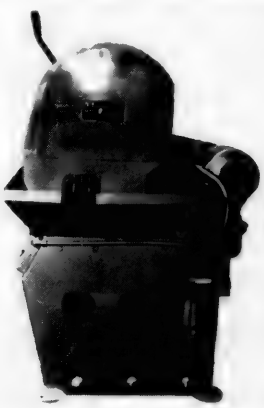
More information? Circle Item 21 on postcard, page 101.

Abrasive Cutting Machine

A Speed-Cut abrasive cutting machine is being marketed by Beaver Pipe Tools, Warren, Ohio.

Called the No. 20, the unit has an abrasive wheel which moves back and forth across the material automatically. Its travel is adjustable from zero to 1½ in. The oscillation (sawing action) coupled with the cooling effect of the liquid, cuts larger solids, producing a polished cut with a minimum burr. A rubber bond wheel is used.

The cutting machine has a circulating coolant pump, with separate motor and control, and a setting tank with two baffles to filter out sediment. The coolant control valve is placed in the front of the machine.



A magnetic switch and air vise is another feature of the machine. Two heavy vise fingers grip the material on both sides of the cut. As the feed handle is lowered into cutting position, it actuates the air valve, and the air vise grips the material. When the wheel is raised out of the cut, the air vise releases. An air pressure regulator controls the vise pressure for protection when cutting tubing or other lightweight materials.

The cutting wheel is completely shielded. This, together with the apron around the machine prevents splashing. A hinged door allows access for wheel changing.

With a 20-in. wheel, the unit can cut 4-in. pipe or shapes, 4-in. round, or 4 x 4-in. solid stock. The wheel speed is 1700 rpm, with a 1-in. arbor; height is 60 in., width, 42 in., and depth, 60 in. The net weight is 1565 lb. and the shipping weight is about 1700 lb. It is equipped with either a 7½- or 10-hp, 220/440-v, three phase, 60-cycle motor.

More information? Circle Item 22 on postcard, page 101.

Line of Condensing Units

A line of commercial refrigeration condensing units for remote condenser applications is being marketed by Copeland Refrigeration Corp., Sidney, Ohio.

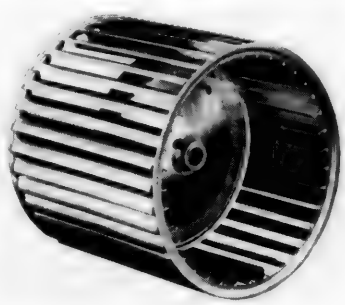
Called the "RCZ" Copelametic series, the units are designed for use with remotely located, air-cooled condensers or in water-cooled systems with cooling towers or evaporative condensers.

Models are available for high, medium, and low temperature applications from 1 to 5 hp and for high temperature applications only in 7½ hp (F-12) and 10 hp (F-22). The high temperature units from 2 to 10 hp are equipped with suction gas-cooled motor-compressors. All other applications use air-cooled compressors except in 5-hp medium and low temperature units requiring a water-cooled compressor.

More information? Circle Item 23 on postcard, page 101.

Blower Wheel Has Center Disc

A center-disc blower wheel is introduced by Air Impeller Div., The Torrington Mfg. Co., Torrington, Conn.



Designated the Type CL Airotor, the wheel is designed to operate at higher speeds than those of conventional blower wheels. The structural center disc is dovetailed under pressure into the encircling blades, forming a compression fit. As a result, the interlocking joint tightens during rotation.

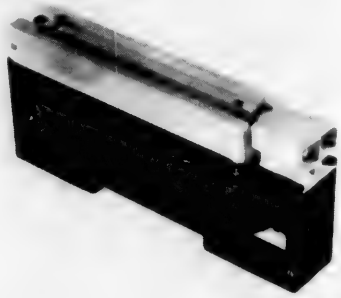
The blower wheel is available in six sizes: 9½ in. diameter (7⅛- and 9½-in. widths), 10⅝ in. diameter (8- and 10⅝-in. widths), and 12⅝ in. diameter (9½- and 12⅝-in. widths).

More information? Circle Item 24 on postcard, page 101.

Motor-Driven Psychrometer

A motor-driven portable psychrometer named the Psychron has been developed by Friez Instrument Div., Bendix Aviation Corp., Baltimore, Md.

Powered by three flashlight batteries, the instrument consists of a matched wet-and-dry-bulb thermometer assembly ventilated by a tiny fan coupled to a motor. The thermometers attain an accuracy of plus or minus 0.3 deg F at any point.



The psychrometer has a built-in illumination system for taking readings in the dark. It weighs 2½ lb and is 10 in. long, 4 5/16 in. high, and 1 13/16 in. wide. The unit's three-bladed aluminum fan pulls in air at the rate of more than 15 fps across the thermometer bulbs, which are placed within a removable air intake. Power for the unit is supplied by standard 1½-v, D batteries.

The instrument operates in a relative humidity range of from 10 to 100% and a temperature range from 10 to 100 deg F.

Standard accessories include a metal carrying case, a Nylon neck strap, an instructional manual, psychrometric tables, and a slide rule. Spare thermometers, wicks, lamp bulbs, and two-ounce water bottles are available as optional accessories.

More information? Circle Item 25 on postcard, page 101.

Indicator Determines Angles

A point indicator which reduces computing and layout time in joining, shaping, drilling, and milling has been designed by Racine Instrument Co., Racine, Wis.

The instrument is a combination angle-finding, center-locating, and leveling device for shop and field use.

Called the Miracle Point indicator, it consists of a mercury-balanced level and degree-calibrated dial enclosed and mounted on a magnetized V-base. It automatically determines angles and center points.

The device can be used by welders, plumbers, electricians, metalworkers, and engineers.

By placing the indicator's base against a surface, such as a board to be leveled, or metal stock to be shaped, the instrument will read off the angle at which the work is being held. It is accurate to within 3 minutes of a degree.

Two Alnico-5 magnets in the base hold the indicator in contact with metallic objects, such as pipes or conduits to be joined, leaving the worker's hands free to adjust the work to the correct angle.

To find the center of an object, such as a section of bar stock to be drilled, the indicator is placed astride it, and turned until the dial reads zero. The V-base junction then indicates the center.

A center punch runs through the instrument to aid in marking hole locations.

Similarly, points can be located at any angle on material to be worked without measuring, computing, or scribing. The indicator is placed on the object and turned until the dial reads the desired angle. The center punch then indicates the correct point location.

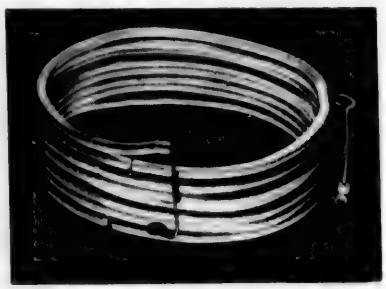
The instrument's working parts are enclosed in a cast aluminum case with a plastic face plate.

More information? Circle Item 26 on postcard, page 101.

Element Preheats Pipe Welds

An electrical resistance heating element has been developed by Arcos Corp., Philadelphia, Pa., for preheating or stress relieving pipe welds.

A basic feature of the element, known as Heat-O-Coil, is a length of small diameter resistance wire. The full length of the wire, except for several inches on each end, is strung with ceramic ball and socket beads.



Each end of the coil is formed into a small ring. After wrapping the coil around the welded section of the pipe for stress relieving, the two ends are connected to the terminals on a welding machine.

Thermocouples are inserted under the coil and connected to an indicating pyrometer. After all necessary connections have been made, the section being treated is wrapped with an asbestos covering.

When the hookup is completed, the welding generator is set at the amperage rate calculated to produce the necessary heat. The pipe thickness, the amount of heat required, and the general conditions affecting the buildup of heat will vary from job to job.

As soon as the desired temperature is reached, as shown by the indicating pyrometer, the welding generator is adjusted manually to hold the correct temperature.

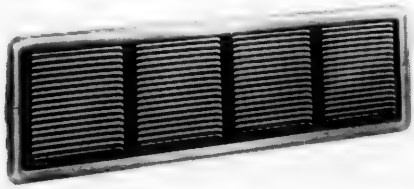
The elements are available in two standard diameters and lengths. Standard length for the ⅛-in. coil, used for large diameter pipes, is 25 ft. Standard length for the 1/16-in. coil, for small diameter pipe, is 10 ft. Special lengths are also available on order.

More information? Circle Item 27 on postcard, page 101.

Return Air Grilles

Two air conditioning return air grilles are being produced by Air Control Products, Inc., Coopersville, Mich.

Designated 21-H (illustrated) for sidewall installations and 23-H for baseboard applications, the grilles are part



of the company's No. 20 Series. They differ from standard models in that their fins run horizontally. This arrangement makes it impossible for room occupants to see into the ducts and permits a more finished appearance on certain sidewall and baseboard installations.

Finished in two-tone chameleon beige, the grilles are available in two sizes that include 24 x 6-in. and 30 x 6-in. units.

Additional information on the grilles is given in Bulletin 181-AC.

More information? Circle Item 28 on postcard, page 101.

Compound Repairs Tanks

A method for repairing metal tanks, pipes, and conduit without welding, using a filled epoxy resin material called Sonite and glass cloth, has been developed by Smooth-On Mfg. Co., Jersey City, N. J.

The resin material is oil and waterproof, resists acids and alkalis, and will withstand temperatures to 200 deg F. It is available in white, designated as Sonite P-2, and aluminum, designated as Sonite P-5.

Repairs can be made with a kit containing glass cloth, stirring paddles, brush and brush cleaner, and the resin compound.

First the hole and surrounding areas are cleaned down to bare, firm metal and washed with the brush cleaner to remove oil and grease. When the metal is dry, a primer, supplied with the repair kit, is mixed and painted onto the patching area and allowed to get tacky-hard. This takes about a half-hour at 70 deg. Then a glass cloth patch of the proper size is placed into position (see illustration) and pressed into the prime coat.

The resin compound is painted over the glass cloth, making certain that it is brushed over the patch edges. A second patch is then placed over the first and the painting operation repeated.

Two glass cloth layers will take care of a hole in a small tank or pipe; three or four are recommended for large tanks or pipes, or for use with acids or alkalis.

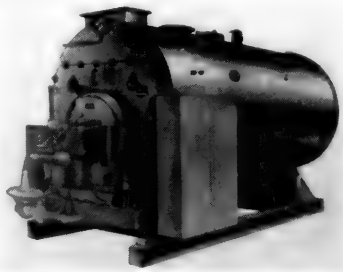
If desired, the completed and hardened patch can be filed or sanded smooth. The patch will harden and the tank or pipe can be used in 18 hours at room temperatures. External heat from any source must be applied if the hardening is to take place properly in cold weather, or if the situation requires a faster cure.

More information? Circle Item 29 on postcard, page 101.

Scotch Type Heating Boilers

Twenty-six Scotch type heating boilers for firing with natural or forced draft gas or oil burners are being marketed under the trade name Queen of Scots by National-U. S. Radiator Corp., Johnstown, Pa.

The boilers are designed to meet the heating and hot water supply requirements of commercial, institutional and industrial installations.



Type SN boilers are available in thirteen sizes for use with popular makes of commercial size oil or gas burners employing natural draft. Net SBI steam ratings extend from 4500 to 35,000 sq ft and SBI net water ratings from 7200 to 56,000 sq ft.

When forced draft oil, gas or gas-oil firing is specified, Type SF boilers are available in thirteen sizes. These have net steam ratings ranging from 6440 to 50,000 sq ft and net water ratings extending from 10,300 to 80,000 sq ft.

The wet back design of the boilers keeps the rear combustion chamber completely surrounded by water-backed heating surface. This reduces the heat losses to the boiler room, and eliminates refractories.

All the boilers have a low overall height. This makes it possible for their installation in boiler rooms where headroom is limited.

The boilers have hinged front doors for inspecting and cleaning the 3-in. steel boiler tubes. There is a rear access opening for inspection and access to the firebox. It has a 4-in. observation port with a protecting shutter in the refractory-protected door.

Reinforced steel support saddles permit mounting the boilers directly on the boiler room floor and eliminate the need for a special foundation.

Tankless and storage water heaters are available for both types of boilers.

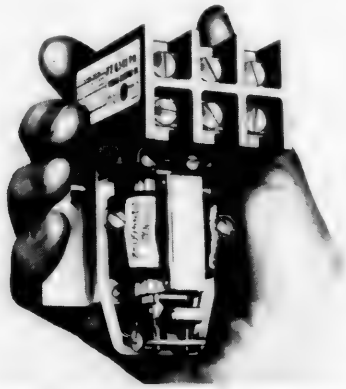
More information? Circle Item 30 on postcard, page 101.

Air Conditioning Controls

Air conditioning and refrigeration controls, offering four control sizes of 20, 30, 35, and 50 amperes, are introduced by the Furnas Electric Co., Batavia, Ill.

The ampere sizes are manufactured to match single and polyphase starter requirements for current rated motors through 550-v.

Features of the controls include: Silver Cadmium Oxide contacts; the magnets require less power, thereby reducing transformer sizes and thermostat contact load; and each pole carries full current.



Other features include contact boards molded under pressure and heat to provide a smooth finished appearance. Their resistance to fungus and arc errosion make them suitable for severe operating conditions. The terminals incorporate pressure connectors which accept and clamp, without looping the line and load conductors. The solenoid assembly floats on a synthetic bushing which dampens vibration.

More information? Circle Item 31 on postcard, page 101.

3000-Gph Submersible Pump

A 3000-gph, submersible pump is manufactured by Kenco Pump Div., American Crucible Products Co., Lorain, Ohio.

Identified as Model 140, the pump is designed for both automatic intermittent operation and for continuous submerged duty. In applications requiring continuous operation the pump can circulate liquids in closed systems

including: cooling evaporative condensor coils, whirlpool baths, swimming pools, and other cleansing and cooling applications. It is also suitable for operations requiring automatic turn-off, such as pumping surface and waste water in intermittent applications, air conditioning condensate removal, surface or seepage water removal from elevator pits, transformer and cable vaults, loading docks, and cellars.

A feature of the pump is a built-in check valve that prevents water from running back into the pit after the pump stops. Another feature is an air lock eliminator that allows rising water to expel air but closes when the pump starts.

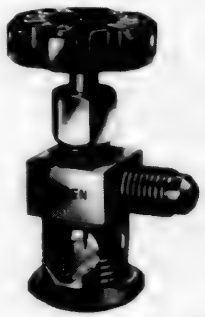
The pump is 7½ in. high, 10 in. wide, and weighs 25 lb net. It has the following capacities at different heads: 2600 gph at 5 ft; 2000 gph at 10 ft; and 1100 gph at 15 ft.

More information? Circle Item 32 on postcard, page 101.

Valve Pierces Large Tube

A tube piercing valve for large size tubing is being produced by Madden Brass Products Co., Aurora, Ill.

Designated Model HP-68, the valve pierces ⅜, 7/16, and ½-in. O.D. tube.



It has a one piece brass body made from extruded bar and a recessed sealing gasket. It automatically centers the tube for piercing and sealing.

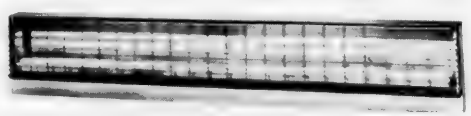
The valve can be installed in any position on copper, aluminum, or thin wall brass tube wherever a liquid, gas, or air flow is desired: in refrigeration; for charging, testing, or purging; for controlling the water supply to humidifiers; and wherever small amounts of water or other liquid, gas, or air take-off is desired when conveyed through non-ferrous tubing.

There is no need to disconnect or shut off the supply, because the valve can be installed on lines under pressure without the use of special tools.

More information? Circle Item 33 on postcard, page 101.

Glass Baseboard Heaters

Electric baseboard heating panels made of quartz glass are offered by Electriglas Corp., Bergenfield, N. J.



Known as Solar Glass, the panels are available in three sizes; 600, 1000, and 1500 watts, measuring 30, 48, and 72 in. in width, respectively. They are 8 in. high and 2 in. deep and can be installed in any combination either completely recessed, semi-recessed, or surface-mounted.

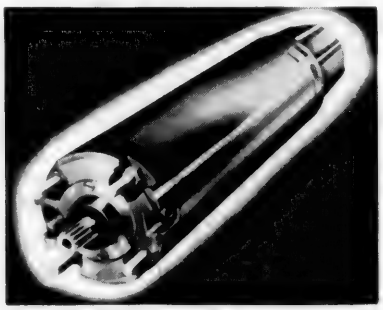
A feature of the company's equipment, which includes wall panels, heat and light units, and commercial ceiling units, is that they are wired for 120 or 240v.

More information? Circle Item 34 on postcard, page 101.

Deep Well Pump Motor

A submersible pump motor has been designed for deep-well water pumping by General Electric Co., Schenectady, N. Y.

To overcome the difficulties of operating while submerged in water, the motor has water-lubricated bearings. It is filled with a proplyene glycol-water mixture and then sealed.



With the aid of a spring, the water-glycol solution is kept inside the motor under pressure greater than that of the water outside. This helps to keep foreign matter out. The pressurized lubrication system prevents ordinary well-water, with its damaging impurities, from entering into the lubricant for an extended period of time. Should well-water enter, a sand slinger operates to keep the lubricating water clean by preventing the entry of foreign particles.

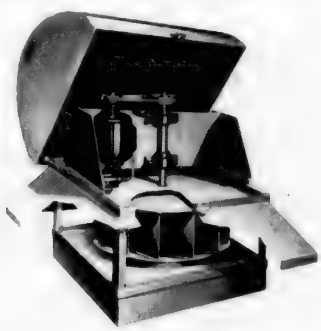
All portions of the motor which are exposed to water are built of corrosion resistant components.

More information? Circle Item 35 on postcard, page 101.

Fan Ventilators

Two centrifugal ventilators are announced by The Burt Mfg. Co., Akron, Ohio, for use in schools, hospitals, dormitories, institutions, arenas, and in commercial and industrial applications where low noise levels are desirable.

Named Centriflow, the fan ventilators are available in



a V-belt drive (illustrated) for large capacities from 675 to 36,430 cfm and in a low profile model of spun aluminum for installations requiring lower capacities from 408 to 2508 cfm.

All models carry the new PFMA certified capacity label guaranteeing ratings.

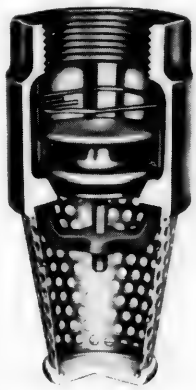
Both units have non-overloading, backward curved blade fan wheels with motors in separate, air-cooled compartments insulated for quietness by resilient rubber vibration pads. Thirteen basic sizes are made in the V-belt model with three basic damper types and motors in all power characteristics from 1/6 to 7½ hp.

The direct drive model, in two basic sizes, offers a choice of four damper types and motors ranging from 1/12 to ½ hp. A package unit, the direct drive model is shipped complete and ready to install on a roof curb.

More information? Circle Item 36 on postcard, page 101.

Foot Valve Has Strainer

A foot valve produced by The Deming Co., Salem,



Ohio, has a tapered, perforated, brass strainer which facilitates installation and provides added strength.

Made of brass, the valve has a stainless steel stem guide and a rubber O-ring to assure positive shutoff. It is produced in ¾, 1, 1¼, 1½-in. sizes.

More information? Circle Item 37 on postcard, page 101.

Color Coding for Copper Tube

A system of identifying types of copper water tube with a variety of colored inks has been adopted by Revere Copper and Brass Inc., New York, N. Y.

Such a system is designed to provide rapid and certain identification of the type of water tube desired, even in warehouses where the lighting is inadequate and the personnel inexperienced.

Other advantages of color-marking this way include simplifying inventories, checking bills of lading and double-checking against building specifications.

The markings will be in the form of a color bar running the full length of the 20-ft tubes. The company trademark of the silhouette of the Revolutionary patriot, the name Revere, and the type letter of the tube will appear in the same color about every twelve inches.

The identifying colors, which are the standard selections of the Copper and Brass Research Association, are green for Type K, blue for Type L, red for Type M, yellow for Type DVW (drainage, waste, and vent), and gray for Type TP (threadless pipe).

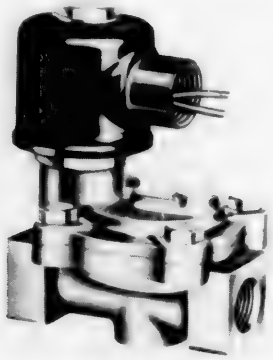
The new markings will be in addition to the present incised marking appearing every 18 in. on the tube, as required by the ASTM.

More information? Circle Item 38 on postcard, page 101.

Diaphragm Type Solenoid Valve

A diaphragm type solenoid valve, designed as an off-the-shelf multi-purpose valve, is being produced by General Controls Co., Glendale, Cal.

Because of its diaphragm action and full flow ports, the valve, known as the K-181, is capable of handling large capacities with a minimum pressure drop, thus making it suitable for shutoff control of a variety of liquids and gases over a range of operating pressures to 250 psi.



The valve will operate in any position, including side and inverted mountings. It is available in ⅜ and ½ in. ips and is offered in two basic models. Standard models handle a range of general applications using air, water, gases, or light oils. Hot water models are suitable for controlling water at temperatures up to 200 deg F for use on coffee makers, hot chocolate machines, soup makers, laundry machines, and various types of vending equipment.

All of the valves are normally closed and feature forged brass bodies, packless construction, and two wire continuous duty solenoids. Valves are also available with an optional waterproof coil, an explosion-proof housing, and a manual opening device.

More information? Circle Item 39 on postcard, page 101.

Water-Cooled Air Conditioner

A 5-ton, water-cooled air conditioner is being manufactured by Armstrong Furnace Co., Columbus, Ohio. The unit is designed for remote application and is similar to the air-cooled line in that the 5-ton air-cooled evaporators or two of the 3- or 2-ton evaporators can be used with its condenser.

In a remote installation the condensing unit can be installed near the evaporator, or it can be located outside the building adjacent to the cooling tower. This latter type installation eliminates the need for the dealer to take extra measures to counteract vibration and compressor noises in the building, although there are vibration eliminators on the spring-mounted Tecumseh compressor.

The water-cooled condenser is the tube-in-tube style designed for chemical cleaning. It has a lower water and refrigerant pressure drop than has the mechanically cleanable design of the smaller units.

All of the internal wiring is done at the factory so that the dealer has only a few simple wiring details to attend. After that he has to run the refrigerant lines and water piping to complete the installation, since the evaporators as well as the condenser are shipped assembled. The condenser is shipped fully charged by the factory with 12 lb of refrigerant, a sufficient quantity to purge the tubing and handle about fifty feet of line.

The control panel in the condensing unit consists of a main contractor with poles for the tower pump, high and low pressure cutout, and a panel board. An auxiliary control panel contains the low-voltage transformer, the switching relay for evaporator fan, and line-voltage and low-voltage terminal strips.

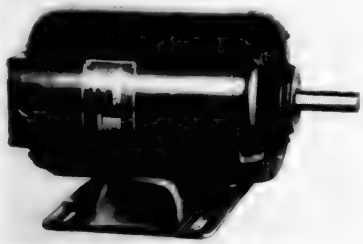
Units are available for both 230-v single phase and 208-220-v three phase.

More information? Circle Item 40 on postcard, page 101.

Combination Frame Motor

An electric motor frame series designated as Frame 566 is available from Doerr Electric Corp., Cedarburg, Wis.

The motor is a combination of low cost, 56-frame components and a base designed to give the shaft height and location of mounting holes of a standard 66 frame. An oversized bearing on the shaft end makes it possible to obtain a ⅞-in. diameter shaft extension.

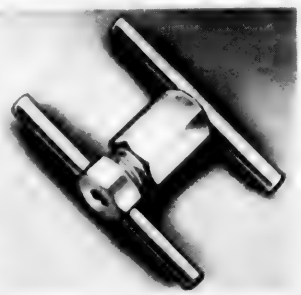


The 566 frame motor will be available as a permanent production model at a slight price differential over comparable ratings in the 56 frame. Motors can be furnished with Type C machined face mounting, open, totally-enclosed fan-cooled, and explosion-proof designs.

More information? Circle Item 41 on postcard, page 101.

Fitting Tests Tubing

A fitting has been designed for leak testing fabricated tubing on all types of equipment by Chicago Forging & Mfg. Co., Chicago, Ill. Called Sealastic, the fitting simplifies leak testing refrigerator evaporators, cold plates, condensers, and compressors. It also facilitates charging, flushing, and evacuation. Available from stock in standard sizes from 3/16 to ½ in., the fitting is adaptable to a range of installations. It has a renewable synthetic rubber seal ring in both solid and ferruled assemblies and is fabricated from cadmium-plated brass.



More information? Circle Item 42 on postcard, page 101.

Pipe Thread Compound

Plastic lead seal pipe thread and gasket sealing compound is available from Crane Packing Co., Morton Grove, Ill., in 1-lb brush top cans (illustrated) and in polyvinyl plastic tubes.

With the cans, a brush may be used to work the compound more thoroughly into threads. Another advantage of the cans is that their entire contents may be used because a brush can extend to the bottom.

The polyvinyl plastic tube will not crack at the seams or separate at the bottom crimp and may be dropped from ladder height with little danger of breaking. The tube will fit into a serviceman's tool box or may be packaged in service kits. The end of the tube is designed to serve as an applicator for the compound.

The sealing compound is permanent and non-hardening and permits the disassembly of connections after several years of service. It withstands pressures up to 6000 psi and temperatures to 500 deg F. It is insoluble in water, steam, gas refrigerants and petroleum products.

More information? Circle Item 43 on postcard, page 101.

Small Hydraulic Trencher

An hydraulic trencher which digs a 2 by 20-in. deep trench at 400 fph, depending upon the type of soil, is offered by M & W Iron Works Co., Inc., Topeka, Kan.

Known as Ditch-A-Line, the entire mechanism is mounted on crawler tracks driven hydraulically. The self-

tightening digging chain is also hydraulically driven and is designed to discharge debris without breaking.

The unit is driven by a 6-hp, gasoline engine with a reduction gear and hydraulic drive. Its length is 83 in., height 42 in., and width 27 in.; its shipping weight is 425 lb. The trencher can be driven up a plank ramp to the bed of a pick-up truck.

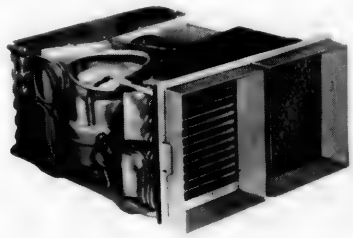
The machine is currently used for the installation of sprinkler systems, gas lines, underground wiring, cable laying, water lines, irrigation ditches, and propane and butane lines.

More information? Circle Item 44 on postcard, page 101.

Commercial Cooling Unit

An air-cooled package air conditioner, powerful enough to cool an entire home, is introduced by Mitchell Mfg. Co. Div., Cory Corp., Chicago, Ill.

Called QR-200, the unit can air condition an area up to 1000 sq ft. It can provide complete air conditioning for a small home or zone controlled cooling for a large home. Because it is air-cooled, the unit requires only a single electrical connection.



The unit requires 17 in. of head room and can be installed in a window, through-the-wall, or in an attic, crawl space, or basement. It is adaptable for use in homes, offices, or stores and comes complete with flanges for connection to duct work. It operates on 230-v, single phase, alternating current and has a 90% power factor.

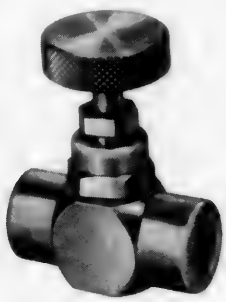
The chassis, which contains the evaporator, condenser, compressor, fans, and fan motor, measures 16¼ x 31½ x 16¼ in.

More information? Circle Item 45 on postcard, page 101.

Brass Needle Valves

A line of low-priced brass needle valves is announced by Generant Engineering Co., Newark, N. J.

Suitable for air and liquid applications up to 600 psi, the valves can be used as shutoff or throttling valves.



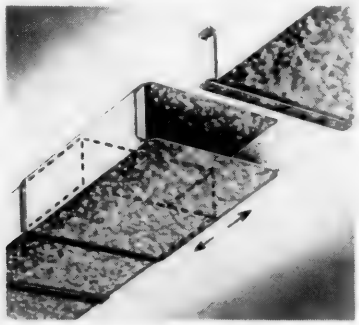
They are machined entirely from brass bar stock; their overall length is 1⅝ in.

Packing between the bonnet and body is eliminated by means of a tapered metal-to-metal seat. The valves are available from stock in all combinations of ⅛- and ¼-in. male and female pipe ports and in ⅜-in. male pipe ports. A detailed bulletin is available.

More information? Circle Item 46 on postcard, page 101.

Telescopic Fitting Connects Ducts

A telescopic connector fitting has been developed by Duc-Pac, Inc., East Longmeadow, Mass., to facilitate the installation of flat duct and fittings for warm air heating or air conditioning installations.



Called Adjusta-Duct, the new product is an adjustable, sleeve-type fitting which eliminates cutting, notching and joining fill-in sections of stack duct.

With the fitting, a fill-in section of stack duct can be installed by telescoping the fitting to fill the opening. Internal and external flanges provide a seal which assures tight connections.

The fittings, on which patents have been applied for, are available in several adjustable lengths.

More information? Circle Item 47 on postcard, page 101.

Surface Temperature Meter

A contact thermometer, capable of indicating surface temperatures on a 1-second contact, is manufactured by Royco Instruments, Albany, Calif., for checking the temperatures of liquids or solids, including insulating materials.

Named Pyro-Couple, the unit combines a surface-contact thermocouple and an indicating meter that is damped for shock resistance and pointer stability. Waterproof

construction of the stainless-steel probe permits its use in a range of fluids. Probes can be made any length up to 60 in. for such applications as scanning areas or volumes of liquids.

For convenience, the scale is calibrated over its 0- to 650-deg F range in both Fahrenheit and Centigrade. Scale accuracy is 2.5 deg F. (A 0- to 1000-deg F range is available, as well). The scales are linear with no crowding at the upper end of the 2⅜-in arc.

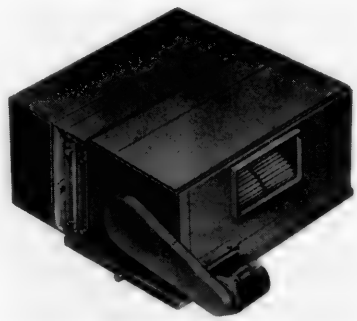
Other features include automatic compensation for ambient temperature permitting readings to be taken almost anywhere; an unbreakable plastic meter face; and a screw-on, probe-protecting shield.

The total weight of the unit, including shield, is 12 oz. and total length, without shield, is 8 in. Maximum diameter is 2½ in.

More information? Circle Item 48 on postcard, page 101.

Combination Air Handling Units

A line of combination air handling units for general applications, including ventilating, heating, and air conditioning, is announced by Sturtevant Div., Westinghouse Electric Corp., Boston, Mass.



Designated as series 1600, the units are available in thirteen basic sizes capable of handling 500 to 48,500 cfm. They are equipped with forwardly curved blades.

Designed for minimum space requirements, all the unit components are accessible, facilitating inspection, lubrication and filter changing. The line features standard blast and steam distributing coils, direct expansion, and water heating and cooling coils.

Installations require a single outlet duct connection. All components, such as the fan section frames and panels, coil casings, filter sections and bypass dampers, are fabricated of heavy gage, galvanized steel.

More information? Circle Item 49 on postcard, page 101.

Cast Aluminum Lavatory

A lavatory for industrial and institutional use is being manufactured by The Dupps Co., Germantown, Ohio.

The unit is self-contained and requires only water and drainage connections for use. The pedestal is made of cast aluminum, and the bowl is made of stainless steel.

Hot and cold water can be controlled separately or mixed. The lavatory is also available with a drinking fountain bubbler with a self-closing valve. The trap is cast in the aluminum base. A high spray-head and soap dispenser divert spray to the bowl only.

Literature, Bulletin S-15-Y, on the cast aluminum lavatory is available from the manufacturer.

More information? Circle Item 50 on postcard, page 101.

(*Continued on page* 122)

74 TONS *of GILSULATE were poured around 1500-foot steam line.*

ONLY 5 MEN *(unskilled) were needed to do the job: two in the trench and 3 above.*

Western Carolina College Chooses GILSULATE® for New Steam Installation

On its modern campus at Cullowhee, N. C., Western Carolina College recently poured 66 tons of type B and 8 tons of type A GILSULATE on a 1500-foot steam line installation. This brought to more than 1200 tons the volume of GILSULATE used by North Carolina institutions, schools and colleges during 1955—enough to fill 40 railroad cars, or a ditch one yard wide by one yard deep and 10 city blocks long!

The installation consists of a 6" steam and a 2" condensate piping system. During pouring, only 2 men were required in the trench and 3 men above to open the bags and pour.

No other insulation for hot underground pipes can match this low-cost performance—just as no other insulation can match GILSULATE for *permanent* protection of piping systems. No wonder more and more engineers, architects and contractors are *specifying* GILSULATE for their hot underground piping work!

Whatever the type of job you have in mind—airport, school, utility, institution, factory, railroad—it will pay you to investigate the unusual features of this easily-installed, dependable, low-cost system. Use the coupon below or see your local GILSULATE dealer.

FACTS ABOUT GILSULATE

1. *EASY TO USE*—just pour and tamp ...pipe heat does the rest.
2. *FORMS 3 ZONES* of protection against heat loss and all hazards commonly encountered by hot buried pipes.
3. *NEEDS NO HOUSING OR MECHANICAL SHEATHS:* no mixing, special handling or equipment.
4. *ONLY NEEDS NORMAL PIPE SPACING:* for multiple pipe or cramped conditions.
5. *THREE TYPES AVAILABLE:*
   Type A for 220°-300° F. temp. range
   Type B for 300°-385° F. temp. range
   Type C for 385°-520° F. temp. range

UNGRADED DITCH. *Concrete pads were located at 10-foot intervals and 4" transite pipe supports placed on top of them.*

THE TRIPLE-ZONE INSULATION SYSTEM FOR LIFETIME PROTECTION OF HOT UNDERGROUND PIPES

GILSULATE®

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The Agents Building
3537 Lee Road, Cleveland, O.

Send me more information on GILSULATE

NAME .....

TITLE .....

COMPANY .....

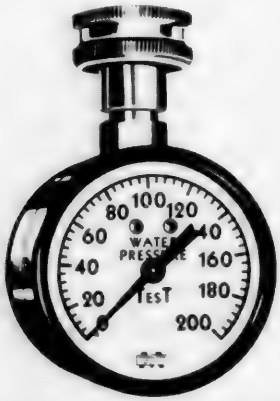
ADDRESS .....

AHV

(*Continued from page* 120)

Gage Measures Water Pressure

A little gage that measures the water pressure in the home is placed on the market by Marshalltown Mfg. Co., Marshalltown, Iowa. It is designed to enable plumbers,



steamfitters, home engineers, appliance salesmen, and air conditioning engineers to obtain water pressure information for the proper selection and setting of relief valves, flush valves, water pressure regulators and other equipment.

The test gage is used for ascertaining the correct pressure of water in homes where installations or repairs are being made. It has a 2½-in. dial with an unbreakable crystal and fits any standard water faucet connection. The dial reads from 1 to 200 psi, and 300- and 400-psi dial readings can be supplied.

More information? Circle Item 51 on postcard, page 101.

Device Counts Spray Droplets

To lighten the task of measuring and counting thousands of droplets, Bete Fog Nozzle, Inc., Greenfield, Mass., has developed an electro-mechanical counter.

Photographic negatives of the enlarged images of the droplets are projected on a screen with an overall magnification of 400 to 1. The operator places a caliper on

the image of a droplet and presses a button. This actuates an electrical counter corresponding to the drops diameter in free air.

The caliper has a sliding switch with a series of contacts machined to indicate the opening between the calipers points. Before and after readings of the counters yield the number of drops in each size range. With this equipment 5400 drops per hour can be classified and counted by an average operator.

The company is equipped to build and sell or lease drop or particle size counters of this type for laboratories or others who may have a need for them. Size range, intervals and number of ranges can be varied to suit individual requirements.

More information? Circle Item 52 on postcard, page 101.

Thermal Conductivity Gage

A new type of thermal conductivity measuring instrument is announced by Hastings-Raydist, Inc., Hampton, Va.

The instrument's thermal conductivity cell incorporates six noble metal thermocouples, arranged in such a manner as to not only compensate for temperature changes in a gas, but also for the rate of change of temperature effects. The thermal conductivity elements are directly heated with alternating current and have an electrical output directly in terms of millivolts.

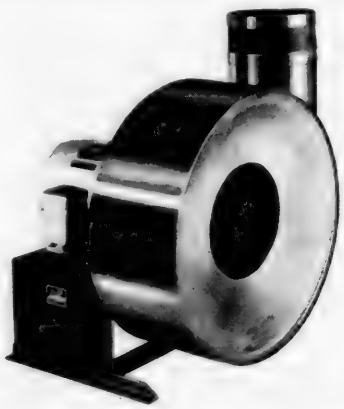
The instrument is suitable for use in the chemical analyses of gases and in the detection of explosive gases and vapors. When used with gases of high thermal conductivity, such as helium, the instrument can be used as a tracer.

More information? Circle Item 53 on postcard, page 101.

Turbo Blowers for Burners

A line of turbo blowers for supplying air to gas and oil burners is placed on the market by Hauck Mfg. Co., Brooklyn, N. Y.

The blowers are equipped with an aluminum impeller and hub in a balanced assembly. The blower casing is



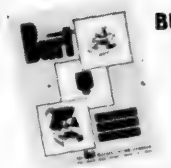
made of fabricated steel with spun steel head equipped with circular reinforcing rings. It is driven by a standard, open frame, ball bearing motor. The discharge position on direct-driven blowers can be rotated in the field to suit connection conditions. A flexible connecting sleeve with clamps is included.

The blowers are made in a number of sizes from 250 cfm at 8 oz pressure to 2650 cfm at 24 oz pressure.

More information? Circle Item 54 on postcard, page 101.

(*Continued on page* 124)

Send for **FREE DATA BOOK**



BURT MANUFACTURING COMPANY
49 E. South St., Akron 11, Ohio

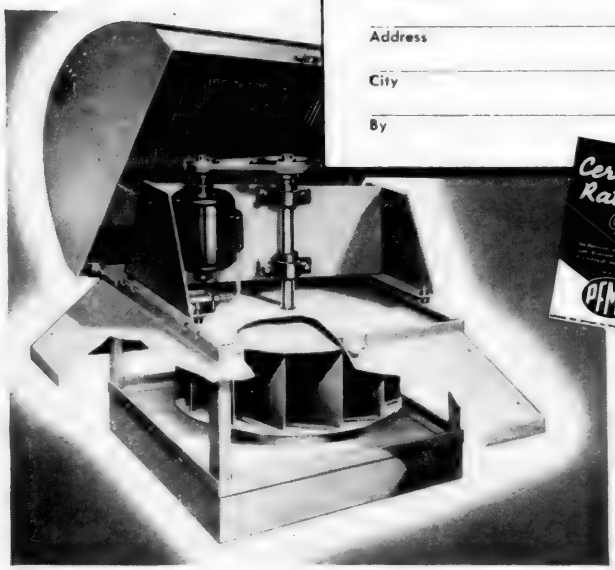
Please send me Bulletin SPV-12A on your new Centriflow Ventilators.

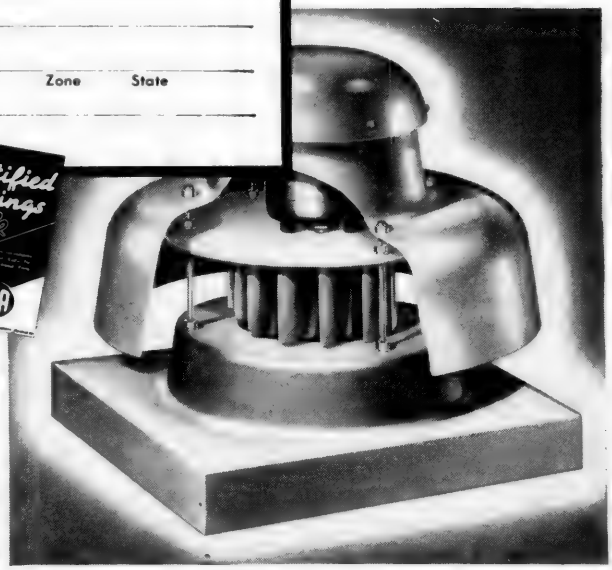
Firm Name _____

Address _____

City _____ Zone _____ State _____

By _____





BURT V-BELT DRIVE CENTRIFLOW

Fit standard roof curb outlets. Power drive in separate enclosure supported on resilient rubber vibration eliminators • Hinged top for easy maintenance • 3 basic damper types • Motors in all power characteristics from 1/6 to 7-1/2 H.P. • Oversize V-belt and sheaves • 13 basic sizes • Capacities from 675 c.f.m. to 36,430 c.f.m.

BURT DIRECT DRIVE CENTRIFLOW

Shipped complete ready to install on roof curb. Low profile spun aluminum with stainless steel supports • Motor in separate compartment on rubber vibration pads for quiet operation • Easy servicing accessibility • 4 basic damper types • From 1/12 to 1/2 H.P. • 2 basic sizes • Capacities from 408 c.f.m. to 2508 c.f.m.

ANNOUNCING

BURT CENTRIFLOW FAN VENTILATORS

Two New Q-U-I-E-T Centrifugals with P.F.M.A. *Certified* Ratings For Schools, Hospitals, Public, Commercial and Industrial Buildings

High efficiency, slow speed and quiet operation are assured with new Burt Centriflow Fan Ventilators. And every Burt Centriflow carries the P.F.M.A. label that **guarantees** its rating to be authentic. Certified capacities range from a low 408 c.f.m. to 36,430 c.f.m. Centrifugal wheels are backward curved blade in non-overloading design. For the complete story, send for the new Burt Centriflow Data Book—just off the press. It's FREE to you.

FAN & GRAVITY VENTILATORS • LOUVERS • SHEET METAL SPECIALTIES

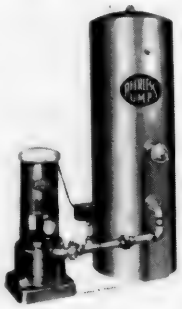
THE Burt MANUFACTURING COMPANY

49 E. SOUTH ST. • AKRON 11, OHIO

(*Continued from page* 122)

Multi-Stage Water Pumps

Deep and shallow well jet pumps, with 3, 4, or 5 stages, are added to the line of domestic and commercial water systems made by Peerless Pump Div., Food Machinery and Chemical Corp., Los Angeles, Calif.



Designed for continuous duty, the single and double pipe jet pumping systems are made to produce up to 3200 gph from deep wells and up to 2200 gph from shallow wells. The automatic pumping units may be installed over or offset in wells as small as 2 in. in diameter. Lifts from depths to 250 ft are available.

The features of the pumps include: a sealed ball bearing motor; a ceramic plastic shaft seal; a mounting bracket that permits alignment of the motor, impellers and pump base; bronze-alloy impellers; a glass pressure gage; a pressure switch mounting; a foot valve and strainer; and an air-volume control. The pump also has an optional piping arrangement which permits piping to be connected for pumping either through the bottom of the pump case or through the side of the pump case.

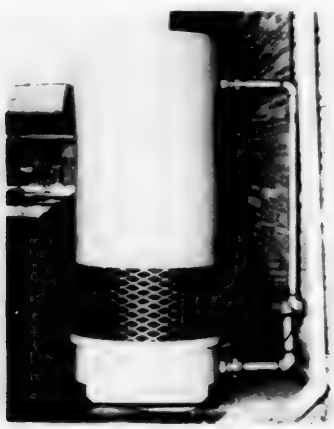
The pumps are finished with a plastic green lacquer. They are further described and illustrated in Bulletin No. B-2422 published by the company.

More information? Circle Item 55 on postcard, page 101.

Cooling Tower Has No Fan

Fanless, induced draft cooling towers for home and industrial air conditioning are made by Koch Engineering Co., Inc., Wichita, Kan.

Air movement and cooling are accomplished by a system of nozzles at the top of the tower. The nozzles, spraying downward, perform two functions: the downward jet of water causes the movement of a large volume of air



through the tower; and the spray nozzles atomize the water into minute particles, permitting a better mixing of air and water. The atomizing process eliminates wood fillers and the baffles.

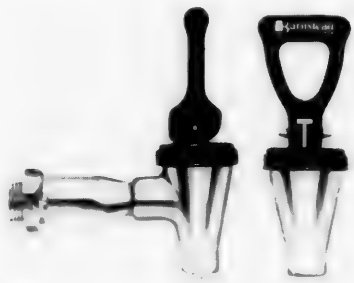
The absence of moving parts eliminates such problems as motor failure, fan replacement, oiling and greasing, belt replacement, bearing and outside electric circuit failure.

Named Carefree, the cooling tower may be installed in any location convenient to water connections from the air conditioner. Only a plumber is needed for installation. The absence of moving parts insures the protection of children from exposed motors, pulleys and belts.

More information? Circle Item 56 on postcard, page 101.

Distilled Water Faucet

A tin-lined faucet for distilled water distribution systems in laboratories and hospitals is made by Barnstead Still & Demineralizer Co., Boston, Mass.



The faucet is constructed of tin-lined brass with a silicon plug and a plastic handle. The tin lining is approximately 1/16 in. thick and is permanently bonded to the metal. It connects to piping by a ½-in. male thread which makes tin-to-tin contact with the company's ½-in. fitting. Accessory fittings for mounting the faucet on a wall are available.

The faucet is both self-closing and non self-closing depending upon which way the handle is thrown.

More information? Circle Item 57 on postcard, page 101.

One-Piece Pressure Seal

A one-piece pressure seal for face-to-face connections is introduced by B. F. Goodrich Chemical Co., Cleveland, Ohio.

Called the Dyna-seal, the sealing device is adaptable to sealing under bolt heads, abutment flanges such as the pipe union, or similar flanges which require sealing between two faces with the bore open to pressure.

The seal consists of an inner sealing member made of Hycar American rubber, heat and pressure bonded to an outer confining steel ring or washer. The device supplies a positive lock washer action and seals pressures up to 10,000 psi against air, water, petroleum products, and many industrial gases and chemicals. The seals function in a temperature service range from −65 to +250 deg F.

The seal is manufactured in sizes from ⅛ to 1¼ in. by Precision Rubber Products Corp., Dayton, Ohio. A high tensile cold rolled steel is used for the washer and is cadmium plated to prevent corrosion.

More information? Circle Item 58 on postcard, page 101.

(*Continued on page* 126)

Even your tricky pipe racking is easier with UNISTRUT® channel

Typical service tunnel in large Midwest university

You make more money with UNISTRUT channel, too—by saving time, men and materials on this foolproof, superior method of pipe racking.

You start with everything you need—channel, clamps, hangers, concrete inserts, rollers or any other accessories. Everything is provided by UNISTRUT from standard stock.

Next, you forget about drilling, welding or riveting. With UNISTRUT, you simply cut the channel to length...slip the UNISTRUT nut in the channel slot...and tighten with a wrench. That's it!

Correct slope or pitch? No problem at all with UNISTRUT—it's completely adjustable. Future alterations or additions? With the flexible UNISTRUT System, you can make them any time.

Study these advantages a few moments—and you'll see why thousands are switching to the modern, high-speed UNISTRUT System for superior support of steam, gas, light conduit, air conditioning or heavy water lines. Get the facts now! Write for 78-page illustrated Catalog 700 giving complete information. Consult your telephone directory today for the name of your nearest UNISTRUT Distributor.

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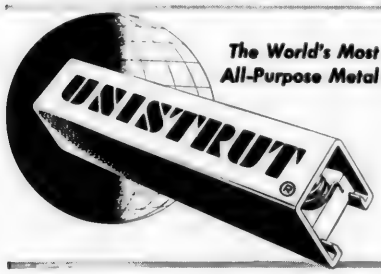
U.S. Patent Numbers: 2327587 2329815 2380379 2363382 2345650 2541908 2405631 2696139 Other Patents Pending



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(*Continued from page* 124)

Fire Alarm Plugs into Outlet

A tiny fire alarm that is installed by plugging into a standard a-c outlet has been designed by Laramie Chemical Corp., Stamford, Conn.

Intended for plants, offices, stores, warehouses and homes, the device can be installed wherever circumstances indicate that a fire may gain costly headway before being detected.

The reusable alarm draws no current except when signaling and serves as a substitute for or companion system to sprinkler and other standard fire detection and fire fighting systems.

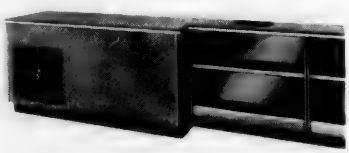
To insure adequate warning time, the thermostat triggers the alarm when the temperature reaches 140 deg F and continues it until conditions return to normal—about 100 deg. It can be tested from time to time by holding a lighted cigarette or match to the circular thermostat button on its face.

More information? Circle Item 59 on postcard, page 101.

Schoolroom Heating System

Automatic, gas-fired, forced air, perimeter heating and ventilating systems, with Util-i-Duct bookshelf sections for schoolrooms, are manufactured by Norman Products Co., Columbus, Ohio.

With the system, each room is individually heated, eliminating the need for a separate building or extra space to house a central heating plant. Any number of additional classrooms can be added later without revamping the heating plant.



The complete classroom package includes the schoolroom furnace and enclosure unit with automatically controlled dampers for mixing outdoor and indoor air and sections which provide air distribution throughout the classroom while furnishing bookshelf space.

Both the furnace and enclosure unit are built of furniture gage steel throughout and have a recessed kick space.

The furnace and enclosure unit can be installed in a right-hand or left-hand corner of the room or anywhere along an outer wall. Models are available with 70,000, 85,000, and 100,000 Btu per hr inputs. Outside air only is used for combustion.

Standard length bookshelf sections can be extended along the outer wall under windows. Each section fits against the wall to form a duct from top to bottom for maximum air passage. Adjustable filler sections, to flush in with wall partitions, and corner sections are available.

Along the top of each section is a perimeter diffuser with a damper and adjustable louvers for balancing the air distribution at correct angles to blanket the outer wall and prevent drafts. The front of each section has rounded shelf edges and corners and the top outer edge has an extruded aluminum rounded trim which can be installed after continuous linoleum or Formica (not furnished) is added along the top.

More information? Circle Item 60 on postcard, page 101.

Plastic Water Pipe

General purpose, flexible plastic pipe, approved by the National Sanitation Foundation for piping water and other fluids for human or animal consumption, is offered by American Hard Rubber Co., New York, N. Y., for jet

and submersible pumps, underground water distribution lines for farm and home, mine drainage lines, and industrial piping systems handling water or corrosive solutions at normal temperatures.

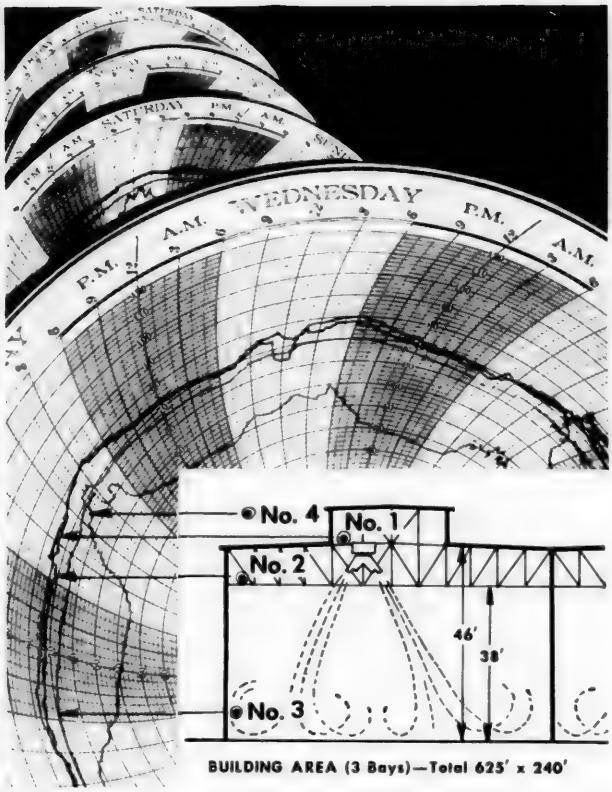
Called Supplex, the pipe is packaged in long coiled lengths. An 800-ft line of ½-in. pipe, for instance, can be laid with only one fitting.

The virgin polyethylene used in pipe is resistant to acids, alkalis, and other corrosive chemicals, is not subject to electrolytic corrosion, and is immune to rot or bacterial attack.

Made in two series, the pipe is available in sizes of ½, ¾, and 1 in. in the 75-lb. Pressure-Rated Series, and in sizes of 1¼, 1½, and 2 in. in the Standard Wall Series. Twin-pipe is also available in sizes of 1 × 1¼ in. and 1¼ × 1½ in. for jet well installations. The pipe may be used at temperatures from 50 deg F below zero to 125 deg above. It retains its flexibility at low temperatures and is not damaged by freezing.

More information? Circle Item 61 on postcard, page 101.

(*Continued on page* 128)



BUILDING AREA (3 Bays)—Total 625' x 240'

Recorded Temperature Readings Prove the Heating Efficiency of Wing Revolving Unit Heaters

Effectiveness of Revolving Distributors is shown by Low Temperature Differential between Roof and Working Level

When the Budd Company's new plant in Philadelphia was erected, twelve Wing Revolving Unit Heaters with No. 8 Distributor Outlets were selected to heat the plant.

The complete and uniform heating of this plant proves beyond question the ability of Wing Heaters to project heated air to the working level and that the two-way revolving heat distributors eliminate discomfort of continuous hot blasts of air from heaters having any form of "stationary" distributors.

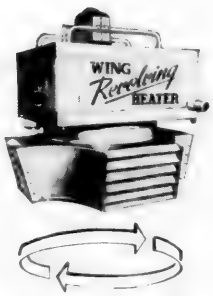
The Budd Company was interested in knowing the vertical temperature gradient so a series of temperature readings between floor and roof was made. For this a four-point recording thermometer was used.

Recordings made over four weekly periods during February, March and April showed the following averages within the building.

Bulb No. 1 (in monitor) ---75.5°F.
Bulb No. 2 (in truss chord) ---73°F.
Bulb No. 3 (at working level)---66.5°F.
Bulb No. 4 (outside) ---ranged between 20° and 70°F.

In summer: With the heaters operating with steam turned off, the revolving distributors produce a pleasant, cooling effect that keeps workers comfortable and more productive.

Details regarding Wing Revolving Heaters are contained in Bulletin HR-6A. Send for a copy.



Four designs of revolving distributors are available to suit different ceiling heights. Photo above shows Heaters with No. 8 Discharge in high ceiling building. At left heater with No. 5 Discharge for low ceiling is shown.

L. J. Wing Mfg. Co. 158 Vreeland Mills Road, Linden, N. J.
Factories: Linden, N.J. and Montreal, Can.
In Europe: WANSON, Haren Nord, Brussels, Belgium

Wing

REVOLVING HEATERS

WING DRAFT INDUCERS

WING FRESH AIR SUPPLY HEATERS

WING FANS

WING BLOWERS

Mail the coupon for bulletin

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Vreeland Mills Rd., Linden, N. J.

Please send me Bulletin HR-6A—Revolving Heaters

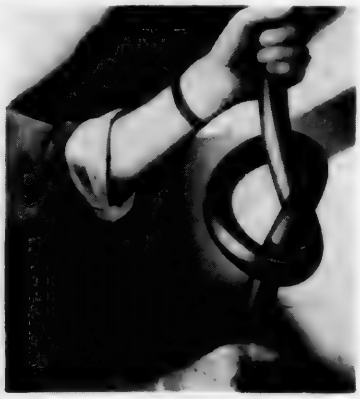
Name.....
Firm.....
Address.....
City..... Zone.... State .....

(*Continued from page* 126)

Cold Tubing Insulation

A flexible, closed cellular, rubber tubing is manufactured by Rubatex Div., Great American Industries, Inc., Bedford, Va.

Developed to stop condensation on copper formed cold lines, the material is a slip-on tubing insulation which



bends without cutting or fitting and fits snugly to any contour of pipes. For application on cold carriers already installed, it can be slit lengthwise, snapped around piping, and sealed with an adhesive manufactured for the purpose.

The tubing has a nitrogen-filled closed cellular structure which repels water and moisture, eliminating the necessity of an additional vapor barrier.

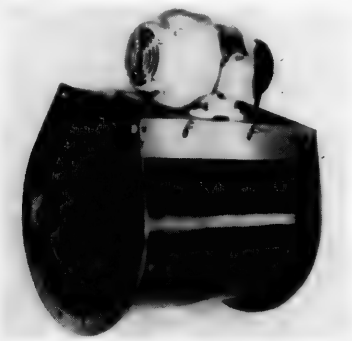
It is manufactured with a minimum inside diameter of ⅜ in. and is produced in any lengths up to 250 ft.

More information? Circle Item 62 on postcard, page 101.

Fans Vent Corrosive Fumes

Axial fans made of solid plastic are added to the line of corrosion resistant ventilation equipment manufactured by Heil Process Equipment Corp., Cleveland, Ohio. The units complement the solid plastic centrifugal blowers and the axial and centrifugal lined and coated steel units now available.

Constructed of either Rigivin (rigid vinyl) or Rigidon (glass reinforced plastic), the fans are suitable for a



range of corrosive services. The rigid vinyl fans are designed for use with strong acid or alkali fumes at temperatures up to 150 deg F. The reinforced plastic fans are recommended for most acid fume services and higher temperatures in the 200-deg range.

Hydrochloric, sulphuric, nitric, phosphoric, hydrofluoric and other acid or mixed fumes can be handled by the fans.

Standard sizes of 18, 24, 30, and 36 in., and larger, are available with capacities from 2000 cfm or less, and upward. All units are V-belt driven and designed with a corrosion resistant seal, a slinger ring, external grease fittings, and an externally vented bearing housing so that the drive is completely isolated from corrosive fumes.

A support attached to the motor base bolts is all that is required to mount the fan into place in a duct system. All sizes are designed for either vertical or horizontal mounting. Flanged ends on the fans permit their use in conjunction with any duct system regardless of the materials used in the duct construction.

More information? Circle Item 63 on postcard, page 101.

Burner Safety Control

A control that programs and safeguards the operating sequence of fully-automatic, rotary register, oil and gas burners is introduced by Electronics Corporation of America, Boston, Mass.

Designated Fireye System FP-2, Model 1012, the control uses two flame-sensitive scanners. One scanner (right) monitors the pilot flame and supervises the light-off sequence, while the other (left) safeguards the main flame. This arrangement provides additional safety against off-ratio firing.

The programming sequence offered in the system was developed for rotary register burners. To insure adequate air flow through the furnace for purging, the air dampers or louvers are driven toward the open position for 15 seconds and then back to the light-off position prior to each light-off.

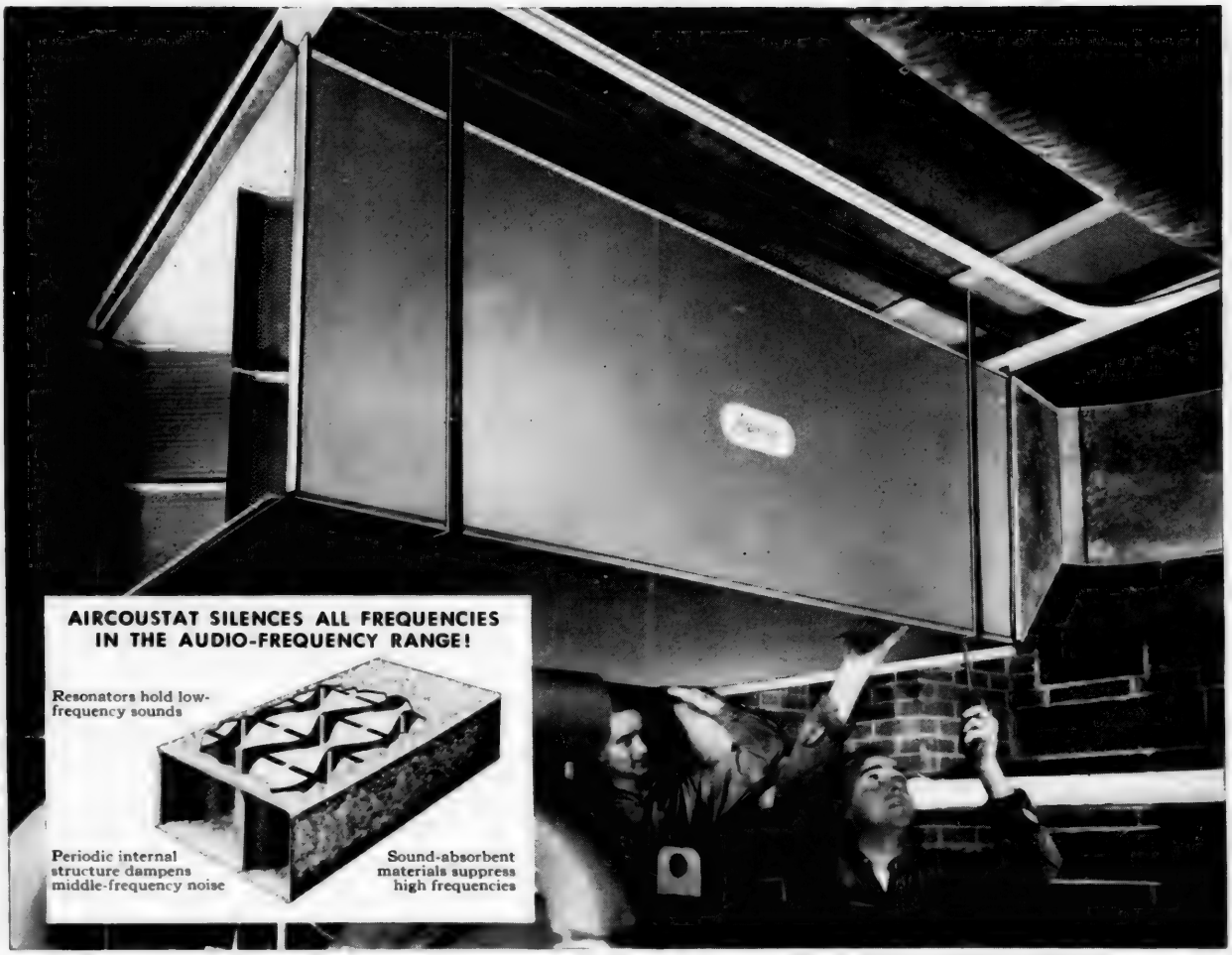
As another feature, the modulator switching circuit will accommodate any line, low-voltage or pneumatic firing-rate control system.

During normal operating procedure, the control provides for pre-purge, pilot proving, limited trial-for-ignition of main fuel and post-purge periods. If a flame failure occurs either during the start-up or operating periods, all fuel is shut off within one second.

Like all the company's safeguard control systems, the new model has both Underwriters' Laboratories and Factory Mutual approval. The system may be used individually or as a component in an integrated panel control system.

More information? Circle Item 64 on postcard, page 101.

(*Continued on page* 130)


AIRCOUSTAT SILENCES ALL FREQUENCIES IN THE AUDIO-FREQUENCY RANGE!
Resonators hold low-frequency sounds
Periodic internal structure dampens middle-frequency noise
Sound-absorbent materials suppress high frequencies

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Acoustical Performance Guaranteed. Easy to Install. Pre-Engineered — No Design or Layout Headaches.

Revolutionary AIRCOUSTAT Sound Traps require no special tools for installation . . . reduce your labor costs and lower your installation time. Units fit any size or shape of duct. If AIRCOUSTAT fits *geometrically*, it fits *acoustically*.

AIRCOUSTAT is the most efficient method of sound-deadening you can provide your customers. A 7-foot AIRCOUSTAT unit suppresses as much sound as 100 feet of ordinary duct lining. AIRCOUSTAT eliminates all frequencies in the entire audio-frequency range, silences entire systems or selected outlets. Flow resistance and pressure drop are lower. 4 series cover applications ranging from general offices to recording studios.

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KOPPERS COMPANY, INC., Metal Products Div., Industrial Sound Control Dept., 6309 Scott St., Baltimore 3, Md.
Gentlemen: Please send me a free copy of your booklet on AIRCOUSTAT Sound Traps.

Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....

(*Continued from page* 128)

Induced Draft Cooling Tower

An induced draft, packaged cooling tower is a new product of Dover Mfg. Co., Independence, Mo.

Designated Series V, the tower because of its vertical rather than horizontal design, requires a minimum of floor space for installation. A centrifugal blower is used to provide the air flow within the tower.

Available in sizes from 5 to 100 tons, the tower may be used for both interior and exterior installations. Because both air intake and outlet are located on the same side, the unit may be placed flush against a wall.

When used inside, the tower can be located adjacent to the compressor, thus eliminating the need for additional piping.

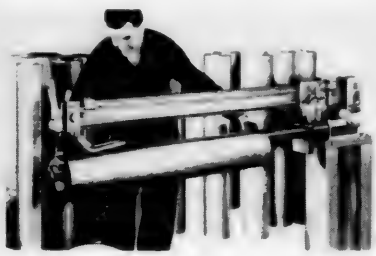
Other features of the tower are: counterflow design; a water distribution system that produces a square-shaped spray; a Z-shaped fill; and hot-dip galvanizing.

More information? Circle Item 65 on postcard, page 101.

New Horn for Lock Seamers

Featuring a multi-purpose horn for closing both single and Pittsburgh lock seams, the Model No. 48-U universal power grooving machine is introduced by Niagara Machine & Tool Works, Buffalo, N. Y.

Furnished as standard equipment, the newly-designed horn can be rotated and locked in any one of several positions for closing single lock seams on inside or outside of square and round work or Pittsburgh lock seams on square work.



Driven by a direct connected gearhead motor, the machine requires less power. Adjustable stops hold work stationary on the horn and adjusting wheels enable close regulation of roll pressure to conform with the thickness of the material.

With a nominal working length of 48 in., the machine has a single lock seaming capacity of 20-gage mild steel and a Pittsburgh lock seaming capacity of 18-gage mild steel.

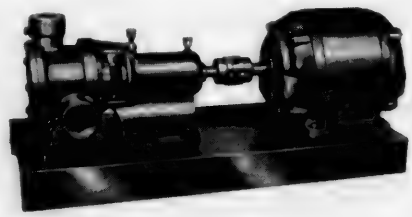
The company's line also includes hand operated and larger power grooving machines. Each of the larger power groovers is equipped with operating controls located at both ends of the machine and an endless chain drive which returns the carriage to the starting position automatically. With six models available for single or Pittsburgh lock seaming, the larger power groovers can be obtained with working lengths from 4 to 10 ft for handling mild steel up to 16 gage.

The Model No. 259 hand grooving machine has a nominal working length of 36 in. and a single lock seaming capacity of 22-gage mild steel.

More information? Circle Item 66 on postcard, page 101.

Pumps Handle Light Liquids

A series of turbine-type, single and double stage process pumps, for handling liquefied petroleum gases, refrigerants and other light non-viscous liquids, is offered by Aurora Pump Div., The New York Air Brake Co., Aurora, Ill.



Known as APCO-Z4, the new series is available in any machinable alloy such as nickel, Monel, or stainless steel.

The pumps operate at low suction head requirements to prevent shaft leakage. A minimum pressure is exerted against the mechanical seal through the use of a built-in pressure relief.

Balance holes on both sides of the impellers equalize the pressures in single-stage pumps, resulting in balanced hydraulic loads. The impeller loads of two-stage pumps are balanced radially by opposing pressures between stages.

More information? Circle Item 67 on postcard, page 101.

Abrasive Pipe Cutter

An abrasive saw, the Abr-A-Saw, that cuts metal or pipe is introduced by Collins Machinery Corp., Los Angeles, Calif.

Features of the saw include a foot-operated, V-wedge, hold-down for locking the material to be cut; a double row of ball bearings with an air seal ring; a full length removable chip and dust tray; and a protective head for operators' safety.

With the saw, 2-in. steel pipe can be cut in six seconds; 4-in. steel pipe in ten seconds; and 4-in. steel channel in eleven seconds. The saw cuts steel pipe, cast iron soil pipe, cold rolled steel, steel angle or channel, galvanized pipe, and other metals. Several pieces of metal, of different sizes and types, can be cut simultaneously with the saw.

More information? Circle Item 68 on postcard, page 101.

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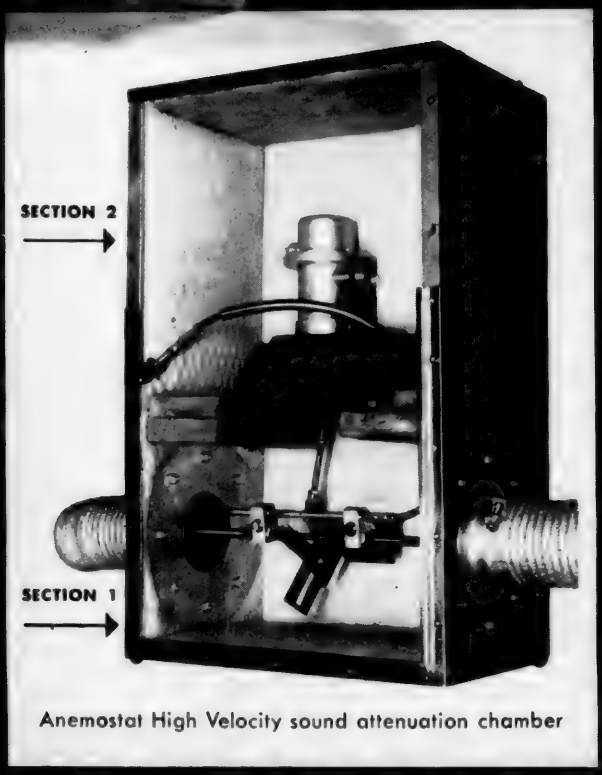
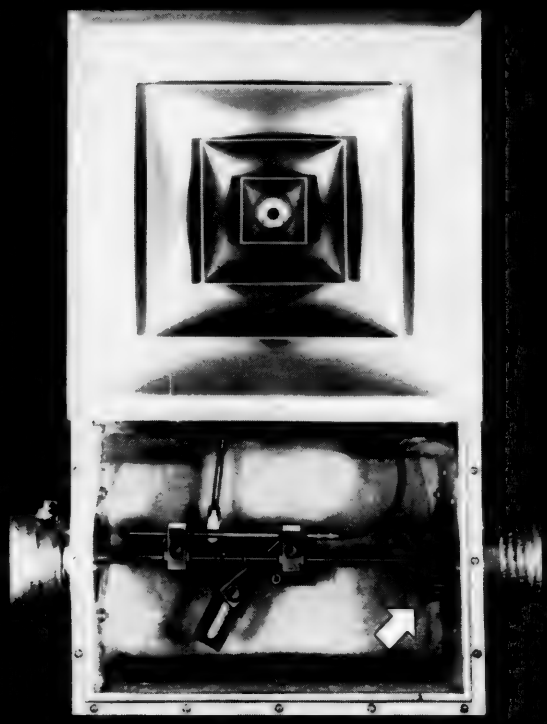
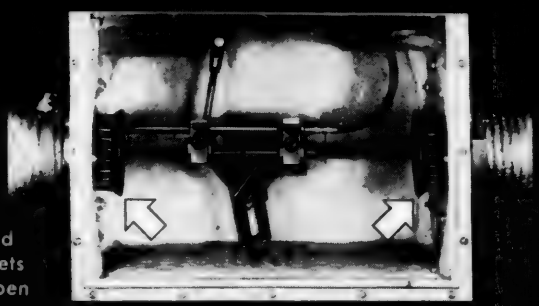


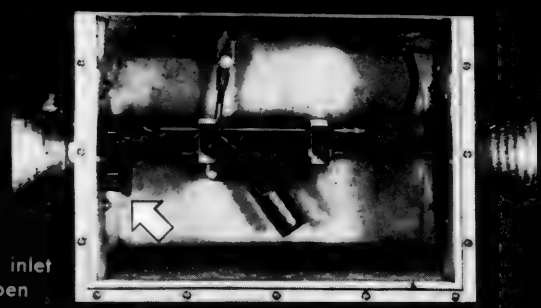
Anemostat High Velocity sound attenuation chamber



Hot inlet open in Section 1.
Anemostat in place covers Section 2



Hot and cold inlets 50% open



Cold inlet open

How to mix and diffuse high velocity air automatically

The Anemostat High Velocity sound attenuation chamber is divided into two sections. Both hot and cold air from the main risers enter Section 1, which is an acoustically lined blending chamber, in which the volumes of air are controlled by the Anemostat serrated rocket-socket valves. When the thermostat is set, the rocket-socket valves move slowly back and forth, thereby adjusting the volume of air supplied through the hot and cold inlets. The velocity of the air which enters Section 1, at from 3500 to 6000 fpm, is automatically reduced by expansion.

As the blended air meets the temperature requirements of the thermostat, it passes through a baffle arrangement into the acoustically lined Section 2 of the chamber, further reducing the db rating of the air.

The air then passes through the Anemostat Air Diffusers, where the aspiration effect causes mixing of room and supply air within the diffuser, resulting in further temperature equalization. The diffuser then delivers to the occupants of the room draft-free air at the desired temperature.

The Anemostat All-Air High Velocity distribution system offers other important advantages. It can be used with smaller than conventional ducts. It can be installed faster and at less cost. It requires no coils, thus eliminates leakage, clogging and odors. Furthermore, Anemostat round, square and straightline diffusers with high velocity units blend into a wide variety of architectural designs.

Write for 1956 New Products Bulletin and Selection Manual 50 to Anemostat Corporation of America, 10 E. 39 Street, New York 16, N. Y.

Anemostat: The Pioneer of All-Air High Velocity Systems

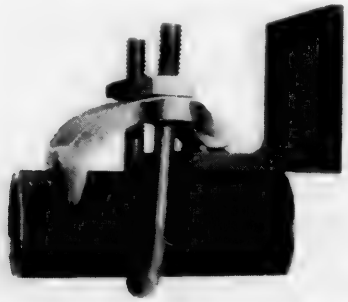
AC-1007

(*Concluded from page* 130)

Pipe or Conduit Clamps

Pipe or conduit clamps are being produced by Fullman Mfg. Co., Latrobe, Pa.

Known as the Latrobe, the clamp is made of malleable



iron, cadmium plated to prevent rust, and a bite made of case hardened tool steel. The safety bite is V-shaped to give a double bite into the steel frame to which it is attached. Attachments may be made without drilling holes into frame work.

The clamp is made in two models: one for right angle support (illustrated) and one for parallel support. Ten sizes are available for pipe or conduit from ½ to 4 in.

More information? Circle Item 69 on postcard, page 101.

Salamander Heats Plants

A gas-fired salamander for heating high ceiling industrial plants is manufactured by Summit Products Co., Uniontown, Pa.

Called the Radi-Heator, the unit can provide heat in localized areas or in plants that do not have central heating systems. It consists of an off-on valve, a circular gas burner, a heat deflector, and legs. There are no moving parts to wear or replace.

All sections of the heat deflector and the 6-in. diameter combustion chamber, which measures 48 in. in height, are made of stainless steel, including the exterior housing and internal baffles that distribute heat along the outer walls of the chamber. The legs are carbon steel, as is the protective wire guard, which is available as extra equipment.

Designed to operate on natural gas, the unit will radiate 125,000 Btu per hr. on 5-oz of gas pressure. It will also operate satisfactorily on manufactured or LP gas. In the former case, the heating capacity of the unit is approximately halved, while in the latter case, based on the higher Btu content of propane and butane, it is nearly tripled.

In operation, the unit comes to a red glow and heat is radiated to surrounding areas. Upward moving heat waves strike the heat deflector and are radiated downward.

An automatic valve, which is available as optional equipment, can be obtained to shut the unit off should the gas pressure drop below operating level. However, no automatic equipment is available to turn on the assembly because, from the safety standpoint, it was deemed best to design the unit for manual starting, and thus eliminate the possibility of an accident due to equipment failure.

The 10-jet burner and iron casting is of the ring type and carries American Gas Association approval.

More information? Circle Item 70 on postcard, page 101.

High Temperature Solder

Tin-antimony (95/5) solder combined with active flux in paste form is being produced by Hercules Chemical Co., New York, N. Y.

Named Swif 95, the solder is recommended for work which requires higher temperatures and pressures than regular solder can handle. It should be used for sweat connections on lines carrying temperatures up to 250 deg F. for pressures up to 500 psi, and for saturated steam up to 80 psi. Thus, it is useful for many heating, refrigeration, and air conditioning applications.

The solder flows at 468 deg. On sweat connections, it is brushed on tube and fitting, then heated with a torch.

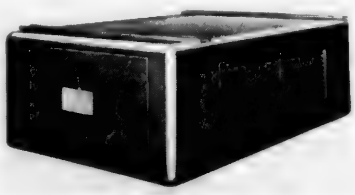
The solder is available in 4-oz, ½-lb, 1-lb, and 3-lb containers, each with a free brush and directions for use.

More information? Circle Item 71 on postcard, page 101.

Unit Heating-Cooling System

A remote, ceiling mounted, year-round air conditioning system is manufactured by Circle-Air Industries, Brooklyn, N. Y., for installation in stores, offices, hotels, motels, and institutions.

Called the Dual Conditioner, the basic unit of the system uses the same piping circuit to cool in summer, heat in winter, and ventilate in the off seasons. They can be



used in fireproof buildings, since in most installations ducts are not needed. For oddly shaped areas, extending ducts are used within the same area. Smoke, fumes or flames cannot be transmitted from one room or area to another.

For cooling only, a remote direct expansion (Freon) refrigerating unit is installed. The water- or air-cooled refrigerating unit is installed on the roof, or in the basement, and the unit suspended from ceiling, thereby using no valuable floor space.

Each unit is its own zone control. Regardless of the size of the installation, the system will not be thrown out of balance if one or more of the units is turned off.

Twenty different models in a range of capacities are available for either free or duct installation in irregular areas.

More information? Circle Item 72 on postcard, page 101.

"No spoilage due to gaseous contamination since installing Dorex"

. . . reports R. A. Kempe, Vice President, Metalphoto Corp., Cleveland, Ohio

"We make photosensitive aluminum plates for direct printing of name plates, dials, scales and similar products," says Mr. Kempe. "It used to be that occasionally batches of plates would be chemically fogged—due principally to low concentrations of sulfide gases from neighboring industrial plants.

"Then we installed Dorex Air Recovery, and the trouble vanished. We maintain a slight air pressure within the area where plates are light sensitized, creating an outward air movement. Ventilating air is admitted only through the Dorex activated carbon filters which effectively extract all gaseous contaminants.

"It's now over six months since Dorex went in and not a single plate has been spoiled due to gaseous contamination. We estimate the cost of the complete Dorex installation to be less than half our loss from just one batch of damaged plates."

If you have an air conditioning, air purifying or ventilating problem, let Dorex engineers help you work it out. For full information, write Connor Engineering Corporation, Dept. B-96, Danbury, Conn.

CONNOR ENGINEERING CORPORATION

dorex®

air recovery

SAVE WITH THESE STANDARD DESIGNS

Drawing on its long and varied experience in manufacturing heat exchangers, ADSCO has standardized the designs of many of its U-bend heaters and coolers. In this standardization program, production costs have been reduced, while the performance ability of the exchangers has been maintained. The result is high ADSCO value with the benefits of standardization passed along to customers.

TANK SUCTION HEATERS
Viscosity of heavy oils and other liquids is reduced by heating so they can be pumped economically. Only liquid to be pumped is heated, eliminating steam waste.

OIL PRE-HEATERS
Highest performance is obtained from fuel oil by heating it properly for complete combustion in burner. Work done by pre-heaters permits use of heavier grade, less costly fuel oil.

CONDENSATE COOLERS
As condensate coolers or waste-heat reclaimers, this equipment transfers otherwise wasted B.T.U.'s to other fluids which must be heated, thus effecting substantial savings.

STORAGE WATER HEATERS
Wide choice of tank materials offered, including solid or clad corrosion-resistant metals, or steel with phenolic resin lining. Of welded construction, in vertical or horizontal types. Removable heating elements of copper U-tubes.

INSTANTANEOUS WATER HEATERS AND CONVERTORS
For heating water for process work or for showers and washrooms. As convertors, these heaters are used for space heating. Of simple U-bend design with removable element.

ADSCO HEATERS AND COOLERS

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BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

FOUNDRY VENTILATION AND DUST CONTROL

Papers presented at the B.C.I.R.A. Conference on Foundry Ventilation and Dust Control, held at Harrogate, England, and the discussion that followed, are now available as a conference proceeding. Information thus made available provides a study of the formation and dispersal of dust, and methods for its elimination or control in foundry operations. The section on the formation of dust and fumes in the iron foundry, gives the results of a fundamental inquiry based on tests carried out by The British Cast Iron Research Association over the last five years.

Many of the contributions deal with the control of dust during operations prior to, and during grinding and fettling. In particular, these cover appliances for grinding and fettling including sand, swing-frame and small portable grinders, and pneumatic chisels.

Foundry Ventilation and Dust Control. Cloth bound, 7¼ x 9½ inches, 255 pages. Published by The British Cast Iron Research Association, Bordesley Hall, Alvechurch, Birmingham, England. Price, $10.

• • •

ADSORBENTS—Bibliography of Solid Absorbents, 1943 to 1953, by Victor R. Deitz. National Bureau of Standards Circular 566, 1528 pages, $8.75. (Order from the Government Printing Office, Washington 25, D. C.). This anotated bibliographical survey of the scientific literature covers the period from 1942 to 1953 and contains approximately twice as many references as are found in the Bibliography of Solid Adsorbents, 1900 to 1942. A complete author index and a complete subject index are features of this circular. The utility of the subject indexing is contained in the main heading which is based on the type of adsorbent and the subheadings which cover some general aspects of the gas or solution phase.

GASKETS—The new American Standard entitled Ring-Joint Gaskets and grooves for Steel Pipe Flanges, ASA B16.20-1956, has been published by The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y. Price $1.00.

ENVIRONMENTAL PHYSIOLOGY AND SHELTER ENGINEERING—Two important research bulletins have been issued by the University of Missouri College of Agriculture, in the field of environmental physiology and shelter engineering with special reference to domestic animals. Bulletin 595 is on Heat and Moisture Removed by a Dairy Stable Ventilation System During Diurnal Temperature Rhythms. Structural heat storage was found to be of major importance in determining ventilation requirements. Bulletin 600 is on Moisture Vaporization by Jersey and Holstein Cows During Diurnal Temperature Cycles as Measured with a Hygrometric Tent. Generally, there were no appreciable differences between the two breeds as far as ratios of evaporative heat dissipation to metabolic heat production. University of Missouri, Agricultural Experiment Station, Columbia, Mo.

COPPER AND COPPER ALLOYS—All of the ASTM Standards pertaining to copper and copper alloys, and related standards have been compiled into a 637-page paper bound volume. It includes 127 ASTM Standards, 12 test methods, two recommended practices, two classifications of copper and copper base alloys plus definitions of terms. Of the material included, 50 of the specifications have been revised and there is a new specification for threadless copper pipe. ASTM Standards on Copper and Copper Alloys, Price, $5.75. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

ATMOSPHERIC CORROSION OF NON-FERROUS METALS ASTM Special Technical Publication No. 175 on Symposium on Atmospheric Corrosion of Non-ferrous metals includes nine papers and results of a comprehensive test program. The exposure tests were started 27 years ago and embraces about 9000 test specimens. Price, $2.75. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

COOLING LOAD CALCULATION GUIDE—Guide No. C-30 has been issued by I-B-R to provide a procedure for calculating accurately the cooling load of residences. It is a companion to guide No. H-20 on Heat Loss Calculation Guide. Institute of Boiler and Radiator Manufacturers, 608 Fifth Ave., New York, N. Y.

INDUSTRIAL HYGIENE FOUNDATION—A 19-page booklet is available on the History of Industrial Hygiene Foundation. It marks the completion of that organization's twentieth year of service to industry in the field of occupational health problems. Industrial Hygiene Foundation of America, Inc., 4400 Fifth Ave., Pittsburgh 13, Pa.

AMERICAN STANDARDS—A 56-page bulletin has been issued by the American Standards Association which lists 1600 ASA Standards and gives the price for each. Many of these special publications are free. It describes the work of ASA and how the standards may be purchased. American Standards Association, 70 E. 45th St., New York 17, N. Y.

AIRCRAFT AIR CONDITIONING LOADS—A detailed guide for aircraft designers in calculating air conditioning loads for aircraft compartments, has been compiled for the Air Force and industry. Engineering Study of Air Conditioning Load Requirements for Aircraft Compartments, OTS, U. S. Department of Commerce, Washington 25, D. C. Price, $4.50.

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FLEXIBLE CONNECTORS

ELGEN SILENT DUCT

*Pats. Pend.

Imagine, this one-piece, factory-assembled metal-to-material unit unrolls absolutely *flat!* No more bothering with unwieldy duct material that buckles easily. Elgen Silent Duct makes on-the-spot work a cinch . . . you just measure and cut. You can fabricate *any type* of flexible duct connector in minutes . . . with half the effort! You can save up to 60%! No more worry about an inventory of "made-up" parts, either. Your choice of U.L. approved, (Gov't. Spec. Mil-D-10860) canvas, *Johns-Manville* asbestos and *U. S. Rubber* neoprene coated fibre glass, in 3" or 6" widths attached to 24 or 26 gauge galvanized steel or 24 gauge aluminum to fill every job requirement. All available in handy-to-use 25, 50 or 100 foot rolls.

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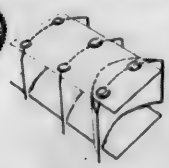
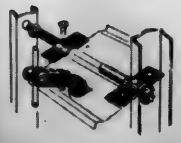


ELGEN ALL-TITE VANE RUNNER
• Quickest and easiest way ever devised for installing turning vanes for square elbows • No special tools required; vanes lock easily with blow of hammer



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For Multi-Blade Dampers . . . Parallel or Opposed • Most perfect damper hardware developed • Assembles in a jiffy . . . cuts assembly time in half • Easily adjusted and self-aligning. Licensed by Minneapolis-Honeywell

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New design Refrigerant Condenser

...gives far more efficiency and better, trouble-free service

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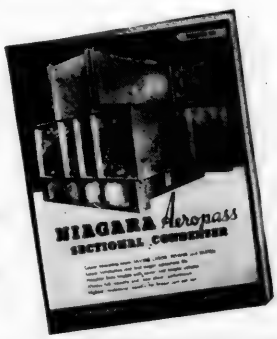
You benefit from extra saving in upkeep labor and expense. The casing of this new condenser is made of sections each separately removable, giving you access to all parts for easy inspection to head off dirt and corrosion, to clean the coils easily from either side.

You benefit from greater efficiency in condensing. A simpler method of using evaporative cooling improves heat transfer. You benefit from Niagara features that remove super-heat before condensing and keep the system purged of oil. You save 95% of the cooling water cost.

You benefit from a low first cost, lower freight cost and less expense in erection.

Capacity range is from 90 to 240 tons. Write for Niagara Bulletin 131. Find out how your plant can save expense this season.



NIAGARA BLOWER COMPANY

Dept. H. V. 405 Lexington Avenue
NEW YORK 17, N. Y.

District Engineers in Principal Cities

NIAGARA *Over 40 Years' Service in Industrial Air Engineering*

NEWS OF THE MONTH

ARI HEAD

deplores lack of trained manpower in air conditioning industry. Suggests program to attract new personnel.

Air conditioning would be making greater strides if it were not for a lack of trained manpower, according to M. M. Lawler, president of the Air Conditioning and Refrigeration Institute.

• **SHORTAGE AFFECTS SALES.**—"Large segments of the public with the desire for air conditioning, and the dollars to pay for it, do not have air conditioning in their homes. Why? Because we did not have the salesmen to call, or the engineers to lay it out, or the installation men to put it in, or we could not get the equipment from the factory soon enough," the industry leader said in an article prepared for Koldfax, a monthly publication for members of the Institute.

The nation's newest mass-appeal industry thus joins other research, engineering and production groups in reflecting the trained manpower scarcity, but Mr. Lawler suggested that the industry vigorously woo personnel into air conditioning and away from other industries in the "annual battle for the graduate crop."

• **PROGRAM TO RECRUIT MEN.**—This could be accomplished, he recommended, through an industry-wide program designed to alert young men to the "golden opportunity that exists in our industry for salesmen, engineers, and installation men, and that will exist for years to come."

Pointing out that the air conditioning industry has lost many young men just entering business or the engineering profession to aviation, electronics, nuclear energy, the oil and chemical industries, and others, he asked "what are we doing as an industry to stimulate the interest and imagination of the high school and college graduate today to create a desire to become associated with us as his life's work?"

"I think that the inter-industry struggle for the available manpower supply is more competitive than the struggle for the available 'disposable dollars'," the industry spokesman said.

CONTROL CENTER

enables central supervision and operation of air conditioning systems in large multi-story buildings

Automation and control centers have been widely used in industry for process control, and the same idea has been incorporated in the Supervisory DataCenter, a new development of Minneapolis-Honeywell Regulator Company, for remotely operating air conditioning systems in large buildings and for checking temperature conditions in various building zones from a central point. It was designed to cut operating costs and to improve efficiency of the operating personnel.

An operator of the Bank of the Southwest Building, dials code number to obtain a temperature reading from one of 400 points.

• **VISIBLE DATA.**—In a typical installation, such as the one installed in the Bank of the Southwest Building in Houston, Tex., and illustrated on the cover of this magazine, the control panels are mounted so that they can be viewed from behind large windows by persons passing through the busy lobby.

Dials give essential information on temperature, flow, pressure and many other facts about the operation of the buildings' heating, ventilation and refrigeration equipment. The panel has a simple diagram to show how the various equipment units and valves fit into the system as guidance for the operator. Switches and indicating gages provide for instantaneous readings of temperatures and simultaneous recordings of conditions from several locations. Pilot lights tell when key equipment starts and stops in any part of the building.

• **OPERATION.**—A trained operating engineer can tell how his equipment is functioning and he can locate trouble spots when they develop—all this without the engineer leaving his desk.

By pressing the proper button on the board, the temperature in that zone is shown on a large dial. For very large buildings with many zones, a special automatically operated telephone dial system is used and the various zone code numbers are dialed for special readings. Controls can then be operated so that automatically the temperature in a zone can be raised or lowered to provide comfort for the occupants.

In the Bank of the Southwest Building in Houston, an operator seated at his desk can dial a code number and read the temperature from one of the 400 points in the building. The number dialed shows in lights on the desk and the temperature reading appears on a scale. If adjustments are needed for proper operating conditions, he can make them without leaving his central control room.

(*Continued on page* 138)

BISON

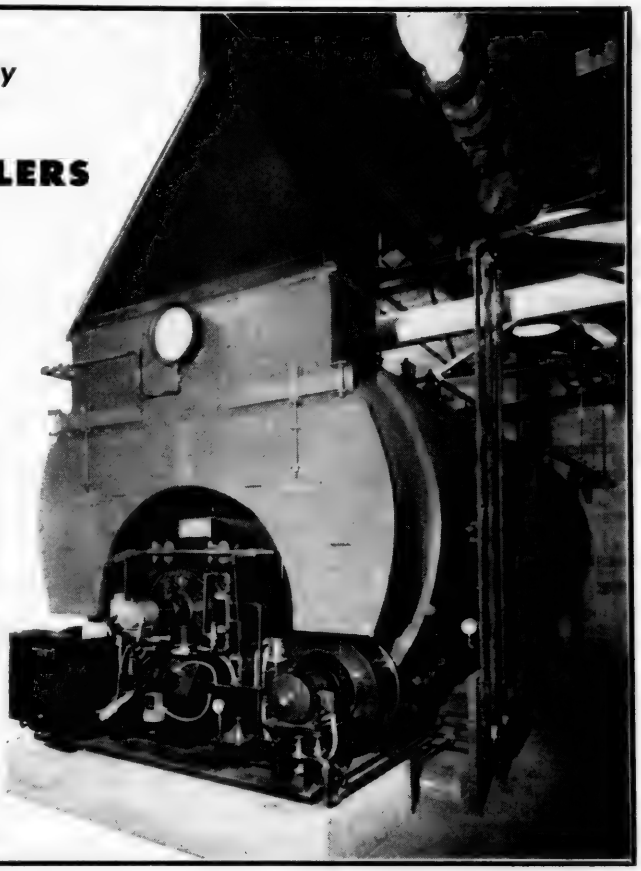
Dependable quality since 1863 . . . . .

POWER BOILERS

Throughout 93 years, Farrar & Trefts has been a leader in boiler design and construction. Today, as in yesteryear, F & T offers dependable, efficient, modern power boilers to satisfy the ever-increasing demands of institutional, apartment, office and industrial buildings. Under the same BISON brand, F & T also furnishes low-pressure boilers for heating purposes.

Proper selection of a boiler for the continuous delivery of required heat and power is a precise project, demanding the systematic approach of engineers long trained in this work. Engineers at F & T have this background of service and they welcome opportunities to evaluate the needs of boiler users.

Standard F & T Super Scot Power Boiler (150 lb. design pressure) with "Indiana Pack" burner at Mastic Asphalt Corp., South Bend, Ind. Furnished by Page Associates of Chicago. The Austin Co. were the Engineers and Contractors.



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ADSCO INDUSTRIES, INC.
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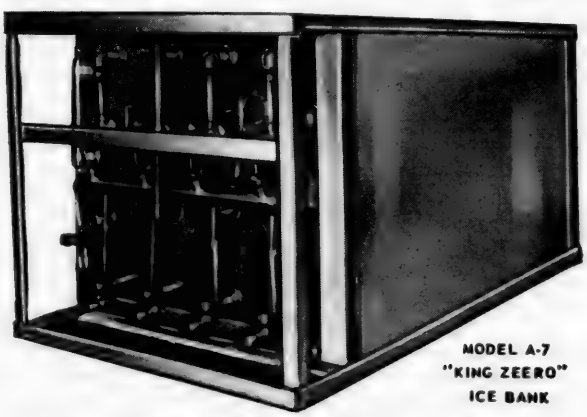
"King Zeero's" Sweet Water ICE BANKS offer ICE-CONCENTRATED Refrigeration for Air Conditioning

CONTINUOUS RIFLED GALVANIZED COILS EXPANSION VALVE CONTROLLED

32°-34° COLD ICE WATER

DESIGNED FOR USE WITH: FREON — METHYL CHLORIDE — AMMONIA

The "King Zeero" ICE BANK is designed for air cooling in Churches, Mortuaries, Theatres, Offices, Stores, Auditoriums, Factories, Clubs, Restaurants, etc. Ice Banks may be added to existing systems for increased capacity.



MODEL A-7
"KING ZEERO"
ICE BANK

The "King Zeero" ICE BANK is designed to deliver tons of 32 to 34 F. ice water for recirculation through air cooling coils. Peak loads many times compressor capacity are easily handled.

- DIRECTED COURSE OF WATER travels with "built-in" agitation.
- NO MECHANICAL AGITATION REQUIRED.
- LARGE WATER COMPARTMENTS spaced on 11" and 12" centers.
- 33% EXTRA ICE CAPACITY safely attained without freezing up.
- ICE IS "BURNED OFF" PLATE COILS progressively, exposing prime and secondary surface for maximum flash cooling capacity.
- ICE THICKNESS automatically controlled - eliminates "freeze ups."
- 94 SIZES to fit space requirements. Other designs for special applications.

CAPACITIES - 500 lbs. to 30,000 lbs. (72,000 B.T.U.'s to 4,320,000 B.T.U.'s) in a single unit. Multiple units may be installed.

MAIL COUPON TODAY

King Zeero Co., 4302 W. Montrose Ave., Chicago 41, Ill

☐ Please send me your new ICE BANK Catalog.

Name _____

Address _____

City _____ State _____

THE KING ZEERO COMPANY
4300-14 W. Montrose Ave., Chicago 41, Ill

CONTROL CENTER

(*Continued from page* 136)

The Supervisory DataCenter is a logical vehicle for the introduction of automation to the operation of industrial and commercial buildings.

• **FUTURE DEVELOPMENTS.**—Although the design described has given satisfactory service, there have been further design advancements so that the new systems which will be installed will not require the pushing of buttons and the noting of temperatures at periodic intervals. Instead an automatic data logging and alarm system will automatically log hourly key temperatures in the air conditioning system and these temperatures will be listed in their proper column on a log sheet by an electrically operated typewriter. If any temperature is out of its normal range, an alarm light will turn on and the temperature will be typed in red on the log sheet.

• **POSSIBLE APPLICATIONS.**—This operating concept is applicable not only to the air conditioning system, but to other phases of building operation so that the Supervisory DataCenter can be expanded to become basic operating centers for entire buildings to include such functions as supervision of building electrical systems, plumbing systems, fire and burglar alarm systems, automatic elevators and complete time programming.

During the past year more than 50 large buildings, shopping centers, hospitals and other structures have installed this system of remote control. One of the earliest panels was installed in the White House in 1952. Installations during the past year include the Prudential Mid America Insurance Company Building, Chicago; the Dallas Federal Savings and Loan Building, Dallas, Tex.; the Pacific Telephone and Telegraph Building, San Francisco and others.

COMPRESSOR SHIPMENTS

increase 37% in first four months of year. Large gain in shipments of automotive compressor bodies.

Manufacturers' shipments of compressor bodies used in air conditioning and refrigeration units were up 37% during the first four months of 1956 as compared with the same period of 1955, it was revealed by Geo. S. Jones, Jr., managing director of the Air Conditioning and Refrigeration Institute.

The figures, which do not include compressors used in household refrigerators nor a relatively small number designed for use with ammonia refrigerant, were compiled from reports made to ARI by manufacturers whose output is estimated to represent in excess of 90% of the industry, Mr. Jones said.

Actual shipments for the four-month period totaled 1,870,966 units, compared with 1,365,670 units in the same period last year. April shipments this year were 523,227 units, against 399,785 in April 1955.

• **AUTOMOTIVE UNITS GAIN.**—Of the four-month total for 1956, 114,620 of the compressor bodies shipped were of the type used in automotive air conditioning. A comparative figure for four months of 1955 is not available, but total 1955 shipments amounted to 255,371 units.

Figures from seventeen reporting companies for compressor bodies (excluding household refrigerators and ammonia refrigerants) are broken down by categories as follows:

Horsepower	Shipments Including Exports April, 1956	Jan. to April, 1956
1/5 hp and under	51,722	188,713
1/4 hp	96,406	317,683
1/3 hp	31,973	123,160
1/2 hp	65,688	170,550
3/4 hp	85,613	372,796
1 hp	82,971	301,898
1 1/2 hp	42,009	138,316
2 hp	7,934	30,435
3 hp	13,253	51,350
5 hp	10,090	35,427
7 1/2 hp	4,269	15,182
10 hp	1,462	4,521
15 hp	810	2,342
20 hp	295	954
25 hp	216	569
30 hp and over	761	2,450
Automotive Air Conditioning	27,755	114,620
Total	523,227	1,870,966

COOLING SURVEY

reveals trend toward air conditioning factories for employees' comfort. Southern factories take lead.

A survey conducted by The Trane Company, La Crosse, Wis., through a country-wide cross-section of its ninety field sales offices, among consulting engineers and architects has revealed a definite trend toward air conditioning of U. S. industrial plants for employees' comfort as distinguished from air conditioning purely for climatic control for industrial processes.

• **TREND IN SOUTH.**—The trend is particularly noticeable in the South, where some consulting engineers have estimated that as many as 75% of new factories—and 50% of all factories—will be air conditioned for employee comfort by 1960, and that 90 to 100% of factories will be so equipped by 1970.

But the trend is spreading also to the North—particularly in factories involving high skills, such as the electronics industry.

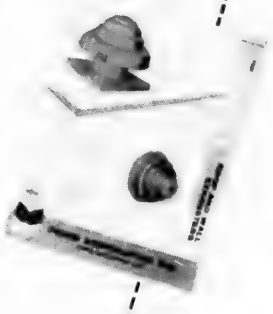
Factors in the trend include competition in industry for skilled help, the desire to maintain employees efficiency in hot weather, and pressure from labor unions.

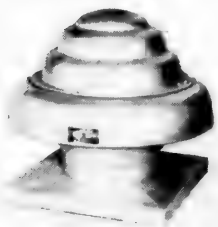
• **POPULAR IN TEXTILE INDUSTRY.**—One of the industries in which the trend is at its fastest is the textile industry. Consultants in this field estimated that 20% of floor space is air conditioned today as against 1% ten years ago. This is exclusive of spaces using evaporative cooling,

(*Continued on page* 140)

NOW AVAILABLE . . the most complete bulletin on spun-aluminum exhausters!

Penn's new Domex brochure, DMX18, has all the facts about centrifugal roof and wall mounted exhausters, as well as axial flow and relief Domex's. Your FREE COPY is available immediately.





DOMEX ROOF EXHAUSTER

More than 60 certified performance tabulations for both direct and V-belt driven roof exhausters are available throughout the range of sizes, and are published in this new brochure. Reliable ratings backed by PFMA certification.

DOMEX WALL EXHAUSTER

More than 12 certified performance tabulations are listed for this newly restyled fan. Its engineered design makes it completely weatherproof. Includes expanding discharge areas.

Your local Penn Ventilator man has full details and is qualified to work with you. Call him . . or write direct.

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FAIRBANKS *All Star Team*

An unbeatable combination — the "first string" team of valve and union for dependable trouble-free piping installations.

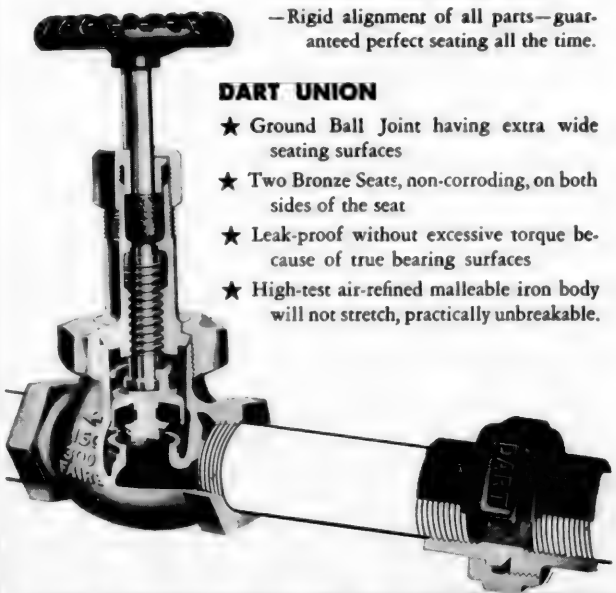
Look at the lineup:

U-01 BRONZE GLOBE VALVE

★ Renewable Composition Disc
Perfect sealing at all times—
A disc for every type of service—
#50—a hard disc for general usage
#52—a rubber disc for cold water valves
#60—a special synthetic disc highly resistant to gasoline, oils and many acids and alkalies.

★ Two Piece Union Bonnet
—Quick, easy disassembly
—No sliding or scraping between body and bonnet—NO WEAR

★ Radial Seat of Two Piece Union Bonnet
—Leak-proof Body Bonnet Joint
—Rigid alignment of all parts—guaranteed perfect seating all the time.



DART UNION

★ Ground Ball Joint having extra wide seating surfaces

★ Two Bronze Seats, non-corroding, on both sides of the seat

★ Leak-proof without excessive torque because of true bearing surfaces

★ High-test air-refined malleable iron body will not stretch, practically unbreakable.

THE **Fairbanks** COMPANY
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VALVES • DART & PIC UNIONS • TRUCKS • CASTERS

COOLING SURVEY

(*Continued from page* 138)

and total floor space includes such areas as warehouses as well as production space.

The company's office at Greensboro went on to report that almost complete air conditioning of textile and tobacco manufacturing areas will be finished by major manufacturers by 1970 and by smaller firms probably by 1980. Very little new construction in either industry will go up by 1960 which is not fully air conditioned, it was reported.

Although textile and tobacco factory air conditioning often can be justified from a production standpoint (i.e., the maintenance of certain humidities for proper operation of equipment), actual inside conditions are specified which go beyond those requirements, with employees' comfort in mind.

• **ESTIMATES OF TREND.**—One of the questions asked in the survey was: "What proportion of U. S. factories do you estimate will be air conditioned for comfort by 1960? 1970? 1980? Please split your predictions between new construction and the addition of air conditioning to existing buildings."

Representative answers are as follows, as reported by various offices after checking with consulting engineers and architects:

	1960		1970		1980	
	New	Old	New	Old	New	Old
Dallas	75%	50%	90%	90%	Above 95% in both	
Houston	50-75% in both types		All present facilities not abandoned by 1970 to be conditioned			
Detroit	7%	3%	21%	9%	60%	30%
St. Louis	No Estimate		25%	10%	70%	20%
Cleveland	7%	4%	20%	15%	35%	25%
For both new and existing factories manufacturing precision and technical equipment: 1960, 25%; 1970, 40%; 1980, 75%.						
New Orl.	50%	Close to 50%	75%	75%	100%	100%
Atlanta	40%	10%	80%	50%	95%	80%
San Fran.	3%	6%	12%	20%	25%	30%
Chicago: 3% by 1960, 15% by 1970, 35% by 1980; 90% of these figures are for new construction.						

MARKET SURVEY

will seek homeowners' attitudes toward central cooling systems. Owners and non-owners to be quizzed.

Homeowners' attitudes toward central residential air conditioning are being studied by the Du Pont Company in the second of its annual series of market research surveys for the air conditioning industry.

• **WILL INTERVIEW NON-OWNERS.**—Personal interviews with 1900 householders are being made in a nationwide "probability sample" of home owners in 27 metropolitan areas. The survey is designed to uncover not only factors of satisfaction or dissatisfaction by those whose homes are centrally cooled, but also purchase plans of those whose homes are not now mechanically cooled. Results of the survey are expected to be announced in November.

The survey is being conducted for Du Pont Company's Kinetic Chemicals Division by W. R. Simmons and Associates Research, Inc., New York, N. Y., under the supervision of Du Pont's marketing research division. Interviews of a half to three-quarter hour duration are being conducted with 600 homeowners whose residences already are equipped with year-round, central air conditioning systems. Non-owners' attitudes will be determined through similar interviews with 300 neighbors of owners and 1000 homeowners in 53 non-rural areas of the nation.

• **SURVEY CONFINED TO PROSPECTS.**—In an effort to confine the survey of non-owners of cooling equipment to those who represent the most likely prospects for central air conditioning, the interviews will be limited to owners of homes valued at upwards of $6500 in the South and at more than $7500 in all other sections of the nation.

The Kinetic Chemicals Division's first air conditioning survey, conducted last fall, was limited to room air conditioners and indicated that only one home in 22 was equipped with mechanical air conditioning at that time. Supplementary data uncovered in that nationwide study of more than 13,000 householders disclosed that only 0.2% of non-rural homes, or about one in every 500, was equipped with a central air conditioning system.

AIR FILTER INSTITUTE

will open permanent office in Washington. Group votes to underwrite joint air filtration research.

At its summer meeting in Washington, D. C., the Air Filter Institute authorized the establishment of a permanent office in Washington at 300 Independence Avenue S. E.

The function of the office will be to carry on the general business of the Institute and also to aid in the clarification of Government specifications on air filtration.

• **WILL UNDERWRITE RESEARCH.**—The Institute also authorized underwriting the joint research project on air filtration by the University of Minnesota and the ASHAE for 1957.

Those members present at the meeting represented 90% of the dollar volume of the air filter industry's sales.

NEW ASHAE CHAPTER

is formed in Austin, Tex. Group is sixty-third chapter of Society. Officers are installed at meeting.

Formation of the 63rd chapter of the American Society of Heating and Air-Conditioning Engineers took place in Austin, Tex., this summer with Society President John W. James of Chicago as the principal speaker.

Also participating in the charter meeting of the Austin chapter were past president Reg. F. Taylor and regional director D. M. Mills, both of Houston, Texas.

(*Continued on page* 142)

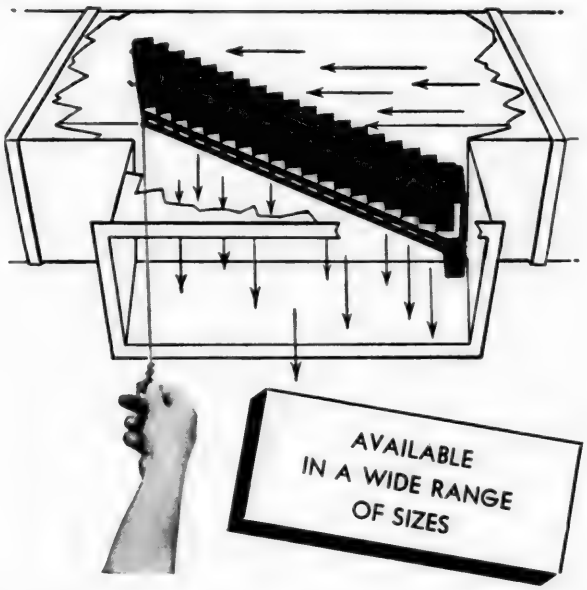
NOW . . . *Divert Air Where You Want It!*

A-J

AIR "EXTRACTOR"

This new A-J Air Extractor gives you maximum control of any forced air system. It's not a "damper type" control to meter available air flow through a grille, but a "scoop" that diverts air from the main duct to branch ducts or grilles and increases output over normal flow where needed.

The curved steel blades of the A-J Extractor are adjustable and act in unison to provide a controlled and uniform flow of air into branch ducts. A single key rod provides fast and easy adjustment through the face of a grille or register, and eliminates need for removal. The extractor is sturdily constructed, and fastened in the duct with two screws. Velocity of the air will not alter setting. Write for full information and prices.



AVAILABLE IN A WIDE RANGE OF SIZES

FREE Catalog listing, describing and pricing 1,000 types and sizes of grilles, registers, etc.

A - J MANUFACTURING Co.

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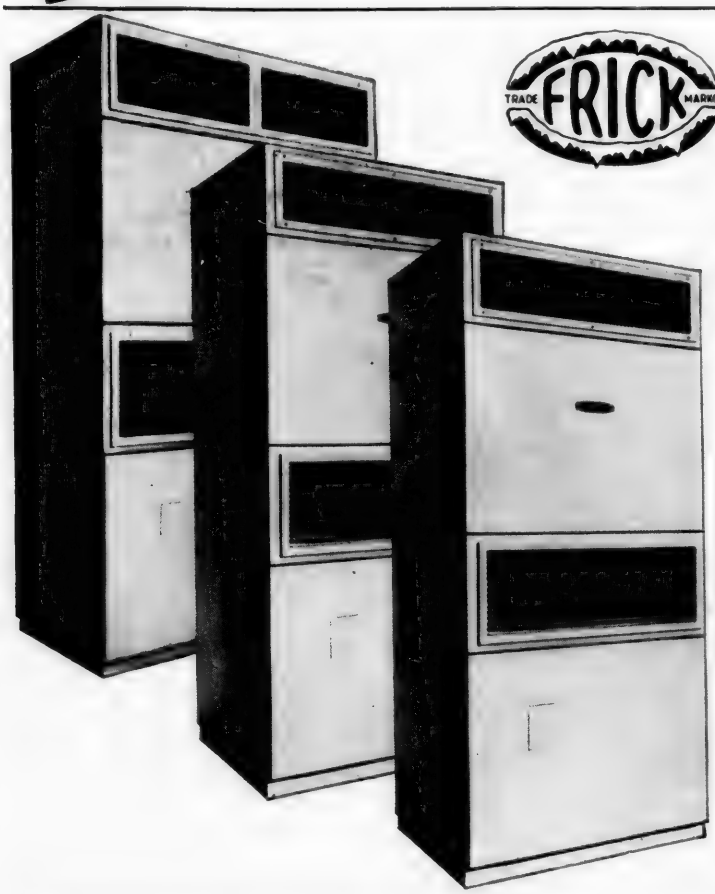


TRADE FRICK MARK

Unit Air Conditioners

Have built into them 50 years' experience in conditioning air, 74 years' experience in refrigeration, and 103 years of successful engineering. Frick unit air conditioners installed in 1938 are still in service — and good for a long time to come.

These superior units are furnished in sizes of 3, 5 and 7½ hp. They have heavier (quieter) cabinets, well insulated; larger cooling surfaces; insulated condensers; conservative ratings; and many other advantages. All are shown in Bulletin 522. Your copy is waiting: write today.

Some desirable territories still open for qualified Distributors.

DEPENDABLE REFRIGERATION SINCE 1882

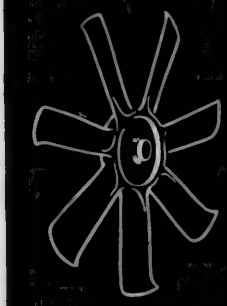
FRICK CO.

WAYNESBORO, PENNA. U.S.A.

more air - less horsepower....

Aerovent 7-blade semi-pressure fans

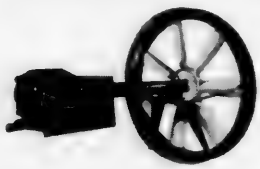
sp-7



Increased operating efficiency and economy without "special" equipment or costly modifications. The secret? It's the design of the new 7-blade "Macheta" Airfoil Propeller!

direct connected

Wider, heavier-sectioned blades, designed expressly to move *more* air at *slower* speeds, require *less* horsepower than conventional types; permit use of *smaller, more economical,* standard-construction motors.

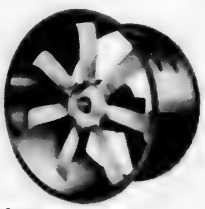


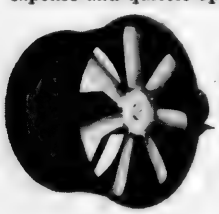
extended shaft

Especially effective against resistances in the 1½" to 4" static pressure range, "SP-7" Fans are adequately powered to prevent motor overload.

direct driven duct

Standard Aerovent assemblies, with "industry's most efficient air-moving surface," now offer the advantage of lower initial cost, reduced operating expense and quieter operation.



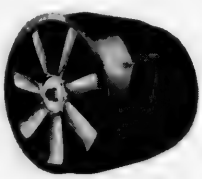


belt-driven duct

Available in sizes 14" to 60" in a wide range of speeds and capacities, these units are supplied for all types of installations and for all operating characteristics.

"bi-flo" duct

Consult your Aerovent representative or write the factory direct for detailed performance data and specific ratings on standard assemblies for every industrial ventilating or air-moving requirement.



All Aerovent Fans are rated in accordance with the Standard Test Code and U.S.D.C. Comm. Std. CS178-51

Aerovent FAN COMPANY, INC.

ASH and BRANDT STS. PIQUA, OHIO

NEW ASHAE CENTER

(*Continued from page 140*)

• **OFFICERS ARE INSTALLED.**—Austin engineers who were officially installed as officers of the new chapter are B. E. Segall, Jr., president; Atwell C. Lagow, vice-president; Perry R. Sisler, treasurer; James L. Rea, secretary; Donald F. Schuett and Ira W. Wilke, board of governors.

Mr. James described an optimistic future for air conditioning and the Society with a constantly increasing demand for air conditioning and a Society of even greater membership.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available

TESTING MATERIALS MEETING—Second Pacific Coast national meeting of the American Society for Testing Materials, including an exhibit, at the Hotel Statler, Los Angeles, Calif. Fred F. Van Atta, assistant secretary of the Society, 1916 Race St., Philadelphia 3, Pa. . . . . **SEPTEMBER 16-22, 1956.**

INSTRUMENT SOCIETY EXHIBIT—11th annual Instrument-Automation Conference and Exhibit (International), of the Instrument Society of America, at the new Coliseum building, New York, N. Y. J. McCaffery, assistant executive secretary of the Society, 1319 Allegheny Ave., Pittsburgh 13, Pa. . . . . **SEPTEMBER 17-21, 1956.**

ELECTRONICS CONFERENCE—12th annual National Electronics Conference and Exhibition at the Hotel Sherman, Chicago, Ill. Victor J. Danilov, Illinois Institute of Technology, Chicago 16, Ill. . . . . **OCTOBER 1-3, 1956.**

AGA CONVENTION—Annual convention of the American Gas Association, at the Auditorium, Atlantic City, N. J. Secretary of the Association, 420 Lexington Ave., New York 17, N. Y. . . . . **OCTOBER 15-17, 1956.**

ANTHRACITE CONFERENCE—An Anthracite Conference will be held at the Mineral Industries College of The Pennsylvania State University, University Park, Pa. P. L. Walker, Jr., Department of Fuel Technology of the University, University Park, Pa. . . . . **OCTOBER 18-19, 1956.**

ASA MEETING—38th annual meeting of the American Standards Association, in conjunction with the Seventh National Conference on Standards, at Hotel Roosevelt, New York, N. Y. Secretary of the Association, 70 E. 45th St., New York 17, N. Y. . . . . **OCTOBER 22-24, 1956.**

CORROSION ENGINEERS EXHIBITION—Exhibition of corrosion control materials will be held concurrently with the south central regional meeting of the National Association of Corrosion Engineers, at the Gunter Hotel, San Antonio, Tex. A. B. Campbell, executive secretary of the Association, 1061 M & M Building, Houston 2, Tex. . . . . **OCTOBER 23-26, 1956.**

AIR-CONDITIONING WHOLESALERS MEETING — Annual meeting of the Air-Conditioning and Refrigeration Wholesalers, at the Jung Hotel, New Orleans, La. Secretary, 2607 N. High St., Columbus, Ohio. . . . . **OCTOBER 24-27, 1956.**

REFRIGERATION ENGINEERS CONVENTION—Annual convention of the Refrigeration Service Engineers Society, at Hotel Muehlbach, Kansas City, Mo. T. F. McDermott, International secretary of the Society, 433 No. Waller Ave., Chicago, Ill. . . . . **NOVEMBER 15-18, 1956.**

ASRE CONVENTION—Semi-annual meeting of the American Society of Refrigerating Engineers, at Hotel Statler, Boston, Mass. Secretary of the Society, 234 Fifth Ave., New York 1, N. Y. . . . . **NOVEMBER 25-28, 1956.**

ASME MEETING—Annual meeting of the American Society of Mechanical Engineers, Hotel Statler, New York, N. Y. Secretary of the Society, 29 W. 39th St., New York, N. Y. . . . . **NOVEMBER 25-30, 1956.**

(*Continued on page 144*)

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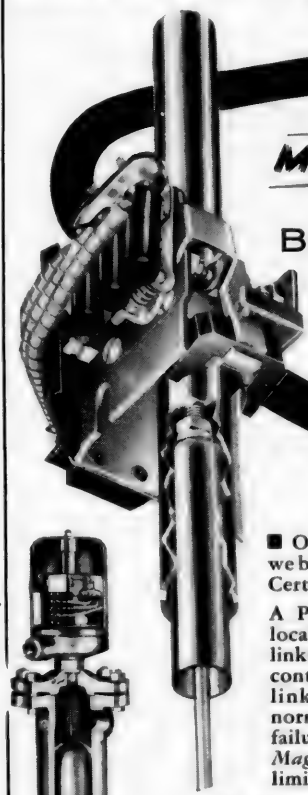

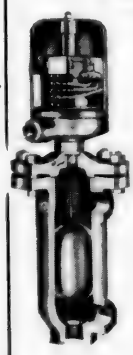

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REPRESENTATIVES IN PRINCIPAL CITIES

(Continued from page 142)

REFRIGERATION CONTRACTORS CONVENTION — Annual convention of the Refrigeration and Air Conditioning Contractors Association, at the Balmoral Hotel, Miami Beach, Fla. Secretary of the Association, 10660 Carnegie Ave., Cleveland 6, Ohio. . . . . **NOVEMBER 26-28, 1956.**

POWER SHOW—The 22nd National Exposition of Power and Mechanical Engineering, under the auspices of the ASME, at the New York Coliseum, Columbus Circle, New York, N. Y. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. . . . . **NOVEMBER 26-30, 1956.**

CHEMICAL EXPOSITION—9th National Chemical Exposition of the American Chemical Society, in the Cleveland Public Auditorium, Cleveland, Ohio. Secretary of the Chicago Section of the Society, 86 E. Randolph St., Chicago, Ill. . . . . **NOVEMBER 27-30, 1956.**

WARM AIR HEATING CONVENTION—Annual convention and committee meetings of the National Warm Air Heating and Air Conditioning Association, at the Netherland Plaza Hotel, Cincinnati, Ohio. George Boeddener, managing director of the Association, 145 Public Square, Cleveland 14, Ohio. . . . . **NOVEMBER 27-30, 1956.**

INDUSTRIAL VENTILATION CONFERENCE—Sixth annual Industrial Ventilation Conference; to be held at Kellogg Center, Michigan State University, East Lansing, Mich. Public relations department of Michigan State, E. Lansing, Mich. . . . . **FEBRUARY 18-21, 1957.**

ASHAE EXPOSITION—International Heating & Air-Conditioning Exposition, at the International Amphitheater, Chicago, Ill. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. Exposition held in conjunction with the 63rd annual meeting of the American Society of Heating and Air-Conditioning Engineers, Inc. A. V. Hutchinson, secretary of the Society, 62 Worth St., New York 13, N. Y. . . . . **FEBRUARY 25-MARCH 1, 1957.**

CORROSION ENGINEERS MEETING—13th annual conference and exhibition of the National Association of Corrosion Engineers, at Kiel Auditorium, St. Louis, Mo. A. B. Campbell, executive secretary of the Association, 1061 M & M Building, Houston 2, Tex. . . . . **MARCH 11-14, 1957.**

ATOMIC ENERGY CONFERENCE—Fifth conference on Atomic Energy in Industry, sponsored by the National Industrial Conference Board, at the Benjamin Franklin Hotel and Convention Hall, Philadelphia, Pa. Public information department of the National Industrial Conference Board, 460 Park Ave., New York 22, N. Y. . . . . **MARCH 14-15, 1957.**

METALS CONGRESS AND EXPOSITION—10th Western Metal Congress and Exposition, sponsored by the American Society for Metals, and other technical groups, at the Pan-Pacific Auditorium and the Ambassador Hotel, Los Angeles, Calif. W. H. Eisenman, managing director of the Society, 7301 Euclid Ave., Cleveland 3, Ohio. . . . . **MARCH 25-29, 1957.**

GAMA MEETING—Annual meeting of the Gas Appliance Manufacturers Association, at The Greenbrier, White Sulphur Springs, West Va. H. Leigh Whitelaw, managing director of the Association, 60 E. 42nd St., New York, N. Y. . . . . **APRIL 8-10, 1957.**

REFRIGERATION INSTITUTE MEETING—Annual meeting of the Air-Conditioning and Refrigeration Institute, at The Homestead, Hot Springs, Va. Executive secretary of the Institute, 1346 Connecticut Ave., N. W., Washington, D. C. . . . . **MAY 6-8, 1957.**

DESIGN ENGINEERING SHOW—Design Engineering Show to be held at the Coliseum, New York City. Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. . . . **MAY 20-23, 1957.**

TESTING MATERIALS MEETING—60th annual meeting of the American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. . . . . **JUNE 16-21, 1957.**

ASHAE MEETING—Semi-annual meeting of the American Society of Heating and Air-Conditioning Engineers, Inc., at Murray Bay, Quebec. A. V. Hutchinson, executive secretary of the Society, 62 Worth St., New York 13, N. Y. . . . . **JUNE 24-27, 1957.**

CIVIL ENGINEERS EXHIBIT—Annual meeting and Civil Engineering Show of the American Society of Civil Engineers at Hotel Statler, New York, N. Y. Secretary of the Society, 33 W. 39th St., New York 18, N. Y. . . . . **OCTOBER 14-18, 1957.**

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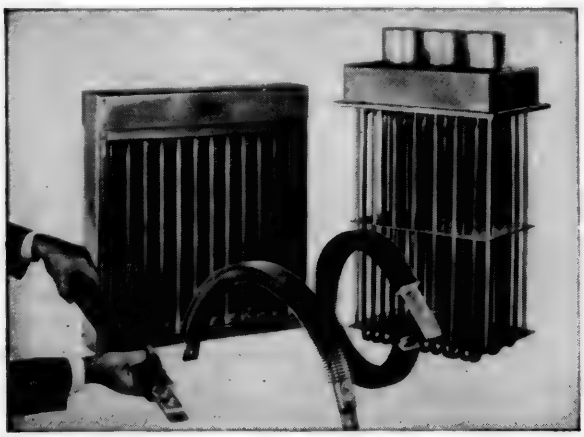

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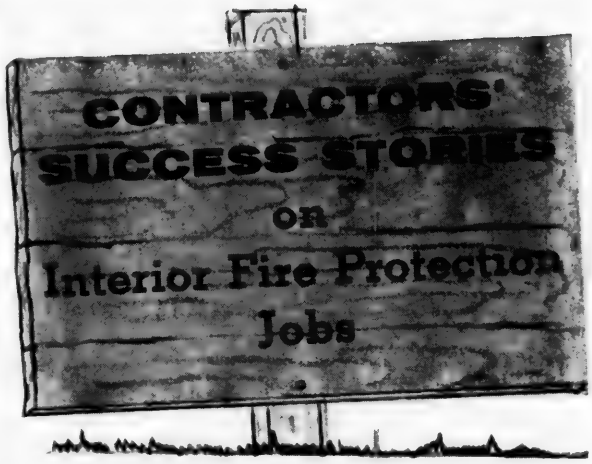

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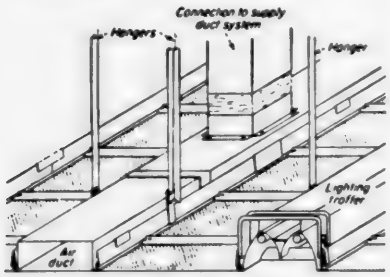

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NEW CATALOGS

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

AXIAL FLOW FAN BULLETIN — A 20-page, illustrated brochure (DAF-101) with performance curves and specifications of axial flow fans is published by Detroit Blower Corp., Franklin Park, Ill. Various fan diameters are listed from 12 to 72 in. with air moving capacities from 1200 to 100,000 cfm. ..... **Item 73**

AIR CONDITIONING BOOKLETS—Two booklets on packaged cooling and heating equipment for homes, stores, and industry are offered by Worthington Corp., Harrison, N. J. One booklet is an example of the company's promotion program; the other gives a summary description of the major home equipment produced by the company. ..... **Item 74**

PROPELLER FANS CATALOG—A revised catalog, Bulletin A-109B, covering a line of propeller fans is published by Hartzell Propeller Fan Co., Piqua, Ohio. The catalog contains new fan sizes not shown in the previous edition as well as revised air deliveries, specifications, performance data and dimensional drawings on the entire line. ..... **Item 75**

STEAM-JET COOLER BULLETIN—A 24-page bulletin, Form 9143-B, covering a line of steam-jet water cooling units is offered by Ingersoll-Rand, New York, N. Y. A series of diagrammatic illustrations in color is used to show how typical steam-jet coolers operate. A listing of the range of sizes available, together with approximate dimensions is included..... **Item 76**

STEEL TUBING FOLDER—Engineers and others involved in the design and operation of heat transfer equipment using tubing at elevated pressures are offered a 4-page technical folder by Tubular Products Div., The Babcock & Wilcox Co., Beaver Falls, Pa. Known as TDC-142A, the bulletin furnishes condensed data on the mechanical and physical properties of seamless and welded carbon steel tubing..... **Item 77**

COMBUSTION CONTROLS PRICES — A price manual, Bulletin CG-71, is being distributed by Electronics Corporation of America, Combustion Control Div., Boston, Mass. The 20-page bulletin contains a listing of the entire Fireye product line to aid in ordering new equipment and replacement parts, as well as to serve as a condensed reference. ..... **Item 78**

CONTROL OF STEAM HEATING—An electronic control system for steam heating installations is described in a 16-page illustrated bulletin (B-901) offered by Warren Webster & Co., Camden, N. J. The bulletin provides diagrams and specifications, and includes case histories. ..... **Item 79**

STEEL BOILER CATALOG—The economic advantages of Pacific LoSet steel boilers for oil firing to architects, engineers, contractors, and building owners are discussed in Catalog AP 279-B, available from Pacific Steel Boiler Division, Johnstown, Pa. Tables, charts, and diagrams in the catalog give sizing, rating, installation, and engineering data for the boilers. ..... **Item 80**

SHEET METAL BROCHURE — A 6-page brochure of industrial and decorative perforated metal sheets for concealing ductwork is issued by The Harrington & King Perforating Co., Inc., Chicago, Ill. Information as to sheet sizes, type and gage of metal, and percent of open area is given in the brochure. ..... **Item 81**

COIL SELECTION DATA—A 36-page catalog, covering the standard line of Tru-Air heating and cooling coils, is released by M. Blazer & Son, Passaic, N. J. Capacity tables and selection graphs in three colors are included. Data are also furnished for selection of water, heating and cooling coils, as well as standard and non-freeze steam coils. ..... **Item 82**

DRAINS ARE CATALOGED—A 96-page catalog covering the Plumb-Easy line of drains and plumbing products is published by Jay R. Smith Mfg. Co., Union, N. J. Described in the catalog in tabbed sections, are floor, roof, area, shower drains and drainage specialties; swimming pool fittings; access boxes; maintenance sinks; hydrants; fresh air inlets; trap standards; and hair, plaster, grease, and oil interceptors. ..... **Item 83**

COOLING CONTROL BULLETIN—A bulletin (710B) describing self-powered cooling controls is available from Sarco Co., Inc., New York, N. Y. Included in the bulletin are operational drawings and hook up sketches. ..... **Item 84**

STEAM COIL DATA—A 12-page catalog on Recold steam coils is offered by Refrigeration Engineering, Inc., Los Angeles, Calif. The catalog gives information on how to select proper coils and tables showing final temperature and heating capacity per sq ft of face area at various pressures... **Item 85**

HEAT EXCHANGER BULLETIN—Bulletin 132 on the Aero sectional heat exchanger is published by Niagara Blower Co., New York, N. Y. the bulletin illustrates and explains the functions of new equipment to provide cooling of liquids in industrial plants independent of a large supply of cooling water. ..... **Item 86**

COOLING TOWER BULLETIN—A line of cooling towers are described in a bulletin (No. 33-104-56) offered by Havens Structural Steel Co., Kansas City, Mo. Wrap around and knock-down dimensional data for the towers are given..... **Item 87**

PLUMBING CATALOG—A catalog of plumbers brass goods is available from The Indiana Brass Co., Inc., Frankfort, Ind. The catalog describes the various plumbing fittings available and gives the number of pieces and pounds per shipping case. ..... **Item 88**

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

REDUCING VALVE HANDBOOK—A line of spring loaded, piston operated and internal pilot actuated, steam pressure, reducing valves is described in a 6-page handbook (BV-56) offered by Atlas Valve Co., Newark, N. J. The booklet offers complete details on design, operating characteristics, function, and application of the valves. ..... **Item 89**

SEWAGE PUMPING MANUAL—An architects' and engineers' reference manual (No. 1114) dealing with pumping and sewage treatment equipment is available from Yeomans Brothers Co., Melrose Park, Ill. The manual gives information for determining capacities and selecting vertical wet pit pumps and pneumatic ejectors for sewage pumping. ..... **Item 90**

BROCHURE ON FURNACES—A brochure on gas-fired winter air conditioners is published by National-U. S. Radiator Corp., Johnstown, Pa. The specifications and dimensions of both horizontal and vertical furnaces are given in the brochure. ..... **Item 91**

WATER TREATING CATALOG—A line of water conditioning equipment is featured in a 20-page catalog available from The Duro Co., Dayton, Ohio. The catalog gives data on domestic and commercial water softeners and filters, including information on how to select them. ..... **Item 92**

VIBRATION BULLETIN — Bulletin SVC-55, issued by T. R. Finn & Co., Inc., Industrial Div., Hawthorne, N. J., describes various types of machinery vibration, gives basic data, formulae and graphs that enable the reader to recognize his own problem, and reviews practical methods of shock vibration and control. ..... **Item 93**

INDUCTION COOLING MANUAL—A 100-page bulletin is offered by The Trane Co., La Crosse, Wis., to aid engineers and architects in the selection, design, and application of air conditioning systems using induction UniTrane air conditioners. Emphasis has been placed on typical induction systems such as might be applied to existing and new multi-room buildings. There are nine different parts to the bulletin. ..... **Item 94**

CENTRAL AIR CONDITIONERS—Central station cabinet type air conditioning units are the subject of a 52-page, data book issued by Worthington Corp., Harrison, N. J. The data book is designed chiefly to aid architects and engineers in selecting the correct size air units for any type installation. The book, divided into six sections and indexed, illustrates pictorially the various vertical and horizontal unit models available and lists their design features. ..... **Item 95**

(*Continued on page* 148)

Above is a quarter-size reproduction of a blotter showing the comparative costs of cast-iron screwed fittings and steel welded fittings. On the blotter you can readily read the figures—and they will amaze you.

For instance, the installed cost of a 6" cast-iron tee is less than 1/3rd that of a 6" steel welded tee. The cost comparisons cover nine sizes each of 90° elbows, tees, and reducing tees; six sizes of eccentric reducers.

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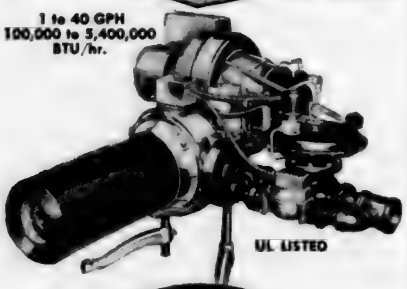

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SYNCHRONOUS FLAME, INC.

WALWORTH • WISCONSIN

NEW CATALOGS

(*Continued from page* 147)

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

GRILLE CATALOG—A 24-page catalog (No. 22) of its complete line of registers and grilles for heating, ventilating, and air conditioning is offered by Register & Grille Mfg. Co., Brooklyn, N. Y. Performance tables and price lists are also included in the catalog. ..... **Item 96**

VIBRATION CONTROL—A bulletin on vibration control for heating, ventilating and air conditioning equipment is available from Vibration Mountings, Inc., Corona, N. Y. The bulletin outlines in detail the various methods available for preventing the transmission of vibration from the equipment. ..... **Item 97**

INSULATION BROCHURE—A 4-page brochure describing Gilsulate insulation for hot underground pipes is published by American Gilsonite Co., Salt Lake City, Utah. On-the-job photographs illustrate the application of the insulation. The brochure discusses the problems of insulating underground piping and offers technical data. ..... **Item 98**

ALLOY STEEL INFORMATION—Technical information on twelve of the most widely used alloy steels is presented in a 4-page folder (TDC-184) issued by Tubular Products Div. The Babcock & Wilcox Co., Beaver Falls, Pa. Included in the folder are condensed data on carburizing and thermal treatments, critical points, mechanical properties and suggestions on welding and machining. ..... **Item 99**

ROOF VENTILATORS CATALOG—A revised catalog, Bulletin A-112A, covering their line of roof ventilators has been published by the Hartzell Propeller Fan Co., Piqua, Ohio. The catalog contains complete information on the Reversible Roof Ventilator as well as the Penthouse, Vertijet, Airjet and Rotary Roof Ventilators. Sizes, specifications, performance data, and drawings are shown. ..... **Item 100**

FORGED FITTINGS CATALOG—A 28-page catalog on forged steel pipe fittings is available from W-S Fittings Div., H. K. Porter Co., Inc., Roselle, N. J. The bulletin, A-3-56, contains dimensional, engineering, and application data on forged screw-end and socket-welding fittings for high pressure service. ..... **Item 101**

MOTOR CONTROL CATALOG—Bulletin No. 5610 with design features and engineering data on air conditioning and refrigeration motor controls is issued by Furnas Electric Co., Batavia, Ill. The 8-page bulletin contains voltage rating charts, outline diagrams, heater coil tables, photos, and list prices. ..... **Item 102**

UNIT HEATER CATALOG—Unit heaters, with horizontal or vertical delivery, for hot water and steam heating systems are described in a catalog issued by National-U. S. Radiator Corp., Johnstown, Pa. The steam and hot water ratings of the heaters are given in addition to diffuser data and roughing-in dimensions. ..... **Item 103**

SWIMMING POOL DATA BOOK—A catalog and data book of swimming pool supplies, chemicals, and equipment is offered by Modern Swimming Pool Co., Inc., White Plains, N. Y. The 52-page book contains data, photographs, and prices of every item needed to build a new residential or public pool, or to equip and maintain an existing pool. ..... **Item 104**

SMOKE INDICATOR BULLETIN—Details of Fireye's smoke density indicator system FE-3 are presented in a bulletin (CM-22) published by Electroncis Corporation of America, Combustion Control Div., Boston, Mass. Illustrated with photos and drawings, the bulletin gives operating and specification data. Installation information is contained in a series of schematic drawings. ..... **Item 105**

WATER SYSTEM CATALOG—A Burks water systems catalog is available from Decatur Pump Co., Decatur, Ill., and its wholesale distributors. Separate sections of the catalog demonstrate the features of turbine pumps, centrifugal pumps, and sump pumps. Each section gives general information about capacities and depths, and shows installations. ..... **Item 106**

COATING CHARACTERISTICS — The characteristics and advantages of water base adhesives and protective coatings for industrial insulations are described in a 4-page folder (I-F No. 46) issued by Industrial Products Div., The Flintkote Co., New York, N. Y. The group of products includes asphalt, tar, resin, and rubber base emulsions and dispersions having bonding and protective coating uses in air conditioning, refrigeration, sound-deadening, and moisture and corrosion control. ..... **Item 107**

AUTOMATIC REGULATORS — Bulletin 56 C, an 8-page condensed catalog of automatic pressure, temperature and level control valves for automatic process control is available from Atlas Valve Company, Newark, N. J. Compiled specifically for operating and design engineers, and production men who have special control problems, this brochure describes a wide range of reducing valves, pump governors, relief valves, temperature regulators, feedwater regulators, float valves, damper regulators and combustion control valves for heating, power generation, chemical processing and other industrial applications. ..... **Item 108**

CENTRIFUGAL PUMP BULLETIN — A bulletin (Form 7223-B) covering a line of cradle-mounted centrifugal pumps is announced by Ingersoll-Rand Co., New York, N. Y. The various models are described and their applications listed on individual pages of the bulletin. In addition, performance tables and dimensions for the line are shown. ..... **Item 109**

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

WHOLESALE PARTS CATALOG — A wholesale buyers' guide, No. 56, with 112 pages of parts, equipment, and accessories for air conditioning, heating, and refrigeration is released by Airo Supply Co., Chicago, Ill. In addition to the lines shown in the catalog during the past 28 years, some of the new lines are Halstead-Mitchell Condensers, Honeywell Controls, Refrigotron leak detector, iron pipe and fittings, Bell and Gossett pumps, Bacharach instruments, Dunkirk and Atlantic boilers. ----------**Item 110**

MANUAL OF DRAINS—Manual LV, illustrating the Leveleze line of floor and room drains, is published by Josam Mfg. Co., Michigan City, Ind. The roof and floor drains are illustrated with application data, code specifications, and ordering information. ----------**Item 111**

RADIATOR BULLETIN—A bulletin on recessed or free-standing radiators is published by National-U. S. Radiator Corp., Johnstown, Pa. The dimensions of the radiators are shown graphically in the bulletin, and the ratings are shown in tabular form. ----------**Item 112**

DUST COLLECTOR BULLETIN—Bulletin No. 920 illustrates the Ventrijet dust collector made by Pangborn Corp., Hagerstown, Md. Fifteen photographs and drawings show the action of the unit. Dimensions, weights and capacities are presented in three tables. ----------**Item 113**

RESISTANCE WELDING CATALOG—A 56-page catalog of resistance welding products, accessories, and materials is available from Weldaloy Products Co., Van Dyke, Mich. The literature describes and specifies standard and special spot welding, electrodes, seam welding electrode wheels, dies, shafts, and bushings. ---------**Item 114**

ROOF VENTILATOR BULLETIN—An illustrated bulletin (DWA-101) describing the Silent-Vent axial roof ventilator is available from Detroit Blower Co., Franklin Park, Ill. Detailed information and performance tables are included in the bulletin. ----------**Item 115**

TWO PRODUCT CATALOGS—The publication of two product catalogs is announced by Brunner Mfg. Co., Utica, N. Y. One (G-141) is a presentation of a line of semi-hermetic condensing units and high-torque motor compressors; the other is a 4-page consolidated catalog, a condensed version of the formal catalog.----**Item 116**

DUST COLLECTOR BULLETIN—A bulletin on the recently developed Cyclo-trell multiple tube dust collector is issued by Research-Cottrell, Inc., Bound Brook, N. J. The 12-page, illustrated bulletin explains the operation and construction of the collector with the aid of numerous drawings, cut-away views, and collection efficiency and capacity nomigraphs.---------**Item 117**

(*Continued on page* 150)

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NEW CATALOGS

(Continued from page 149)

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

COOLING PRODUCTS CATALOG—Bulletin R-11 describes and tabulates the air conditioning and refrigeration products manufactured by Remco, Inc., Zelienople, Pa. Described in the catalog are drier-filters, liquid indicators, check valves, and accumulators. ---------- **Item 118**

FAN COIL UNIT BULLETIN—A bulletin on fan-coil units for hot and chilled water systems is available from National-U. S. Radiator Corp., Johnstown, Pa. The bulletin gives the nominal capacities of the units for both heating and cooling and also lists the dimensions. ---- **Item 119**

TUBING FOLDER—A 6-page folder (TB-413) covering extruded products is published by Tubular Products Div., The Babcock & Wilcox Co., Beaver Falls, Pa. Included in the folder are a list of the ferrous and non-ferrous alloys which have been successfully extruded into tubing, solids, and shapes. ---------- **Item 120**

EXPANSION COIL RATINGS—A complete set of ratings for the selection of direct expansion coils is offered in Recold Catalog 52C6a by Refrigeration Engineering, Inc., Los Angeles, Calif. The 28-page catalog provides tables covering entering air conditions of 50 to 85 deg F wet bulb in 1-deg increments, 55 to 105 deg entering dry bulb, with refrigerants from 30 to 50 deg and velocities of 400 to 600 fpm at 50-fpm intervals. ---------- **Item 121**

METER BULLETIN—A catalog, No. 136, on air meters, vacuum gages, and flowmeters is available from Hastings—Raydist., Inc., Hampton, Va. The catalog illustrates the meters and describes their features and applications. A price list for the instruments is also available with the catalog. ---------- **Item 122**

BASICS OF COMBUSTION CONTROL—The fundamentals of combustion control are considered in detail in the first of a series of publications issued by Cleveland Fuel Equipment Co., Cleveland, Ohio. The publication considers the basic fundamentals of controls to all systems and includes a list of control terminology. ---- **Item 123**

TESTING AND RESEARCH DATA—To enable executives, engineers and others in industry and government to evaluate its capabilities, a 72-page bulletin covering its services and facilities is published by Electrical Testing Laboratories, Inc., New York, N. Y. The bulletin catalogs the laboratory equipment available for assignments in the fields of testing, applied research, and analysis. ---------- **Item 124**

BOILERS ARE DESCRIBED—A 4-page bulletin, entitled Meet the Titusville Boiler Family, is offered by Titusville Iron Works Div., Struthers Wells Corp., Titusville, Pa. Included is a range of power and heating boilers from 97 to more than 8000 sq ft of heating surface. ---------- **Item 125**

PLUMBERS PRICE CATALOG — Price Catalog No. 76 of plumbers brass goods has been revised by Bridgeport Brass Co., Bridgeport, Conn. The revised edition of the catalog reflects numerous adjustments made throughout the entire line and includes new list prices applicable to items to which a standard quantity discount applies. ---------- **Item 126**

SYNCHRONOUS MOTOR BULLETIN—The construction features of large, end-shield bearing, synchronous motors are described in literature released by Allis-Chalmers Mfg. Co., Milwaukee, Wis. The literature is entitled Bulletin No. 05B8305. ---------- **Item 127**

HEATING CATALOG IS REVISED—A revised catalog (27-620) that describes industrial electrical heating units and devices is available from Westinghouse Electric Corp., Pittsburgh, Pa. The catalog contains information and design selection charts on strip heaters, natural and forced convection air heaters, oven heaters, immersion heaters, cartridge heaters, melting pots, industrial hot plates, and heater control equipment. ---------- **Item 128**

AIR FILTER BULLETIN—A bulletin on electrostatic filters is issued by Hadley Products Co., Inc., Marietta, Ohio. The bulletin lists the standard sizes available and gives packaging information on the filters. ---------- **Item 129**

PUMP LOCATION IS DISCUSSED—An engineering release on the pressure effects of pump location relative to the compression tank is available from Bell & Gossett Co., Morton Grove, Ill. The release offers an answer to why certain large circulated water systems have exhibited problems such as unheatable top-floor circuits, noisy, cavitating pumps, and unventable airbound radiation. The answer to virtually all these problems lies in the proper placement of the compression tank on a system. ---- **Item 130**

OIL BURNER NOZZLE BOOKLET—A 12-page booklet, entitled Oilburner Nozzles: How They Work, How to Use Them, is released by Delavan Mfg. Co., West Des Moines, Iowa. The booklet explains the functions of pressure-atomizing nozzles and the part they perform in the combustion of fuel oil. It also discusses the effects of pressure, gravity, viscosity and temperature on nozzle performance. ---------- **Item 131**

DIFFUSERS ARE CATALOGED—A catalog covering a line of diffusers, registers, and grilles for heating and cooling is issued by The Lima Register Co., Lima, Ohio. The 32-page 1956 catalog includes installation and air diffusion pattern photographs, specifications and performance data, and helpful engineering information. ---------- **Item 132**

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

SERVICE MANUAL—A manual for servicing water-cooled equipment used in connection with refrigeration and air conditioning systems is published by Chemical Solvent Co., Birmingham, Ala. The manual expains the use and application of two preparations—one for cleaning and the other for preventive maintenance—which remove and inhibit scale, algae, and corrosion in cooling towers, evaporative condensers, and water-cooled condensers. ..... **Item 133**

CONDENSED VALVE CATALOG—An 8-page condensed catalog, No. C-7, on a line of thermostatic control valves is released by the manufacturer, Lawler Automatic Controls, Inc., Mt. Vernon, N. Y. The catalog contains brief descriptions as well as engineering data concerning the firm's line of shower mixing valves, steam temperature regulators, water controllers, hospital and photographic temperature control assemblies, tempering valves, and other products. ..... **Item 134**

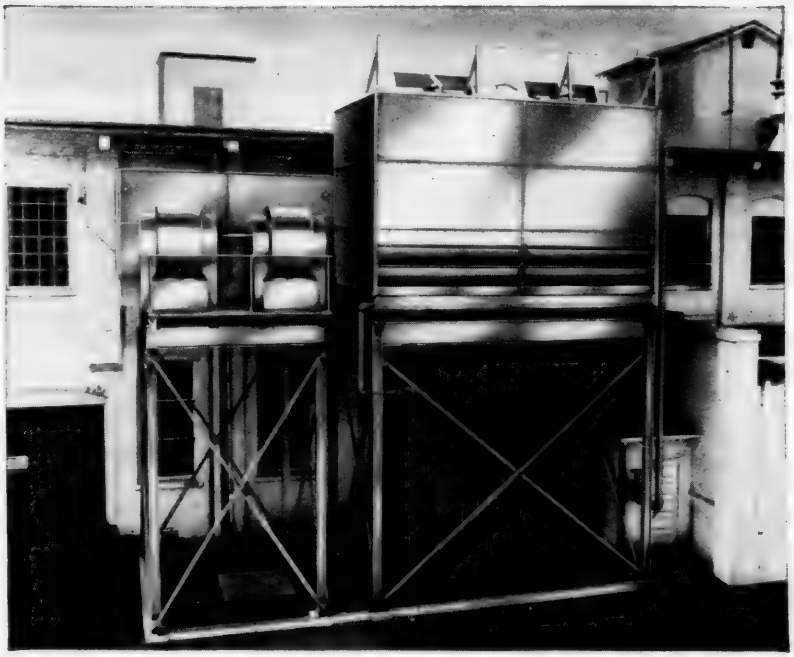
VALVE CHECK CHARTS—An aid in helping valve users to select the proper valve for a required service is offered by The Kennedy Valve Mfg. Co., Elmira, N. Y. Two valve check charts, one for bronze globe valves and one for iron-body valves, describe the basic gate, glove and angle, and check valve types and give information on their design, operation, service characteristics, and proper use. The charts contain special sections dealing with bonnet, stem and seat, and disc types, materials and operating characteristics. ..... **Item 135**

ZONE CONTROL HANDBOOKS—Two handbooks for installers of warm air zone control systems are published by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. The booklet designed for the sheet metal worker (Booklet SA2667) tells when zoning should be used. It explains the installation of dampers, linkages and damper actuators. Electrical circuit diagrams, installing instructions, and check-out procedures for various zoning methods are contained in the installer-electrician serviceman booklet (SA2820-1). In it are discussions of two-zone balancing, volume and mixed-air methods of zoning; internal circuitry and operation of damper actuators and control panels. ..... **Item 136**

TUBE EXPANDER CATALOG—Information about tube expanders and associated tools used for tube rolling is given in Catalog No. 88 published by Thomas C. Wilson, Inc., Long Island City, N. Y. The illustrated catalog, containing 119 pages, will be of interest to engineers and superintendents responsible for the maintenance or manufacture of such equipment as boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections are devoted to expanders, general accessories, measuring instruments, rollers, extensions, and drives..... **Item 137**

MOTOR SELECTOR CHART—Characteristics and performance ranges of fractional horsepower motor types are charted in detail in a motor selector chart available from Howard Industries, Inc., Racine, Wis. Speed-torque curves for basic motor types are illustrated as well as other motor data. ..... **Item 138**

(Continued on page 152)



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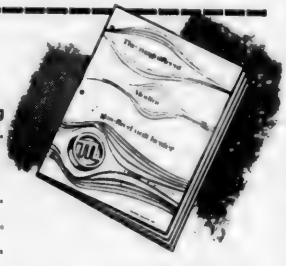


NEW CATALOGS

(*Continued from page* 151)

Use the prepaid postcard on page 101 for securing your copies of catalogs described in this department.

PRESSURE REDUCING DATA—A 20-page bulletin (EN656PRV) on pressure reducing valves is issued by Hoffman Specialty Mfg. Corp., Indianapolis, Ind. The bulletin is illustrated throughout with typical installations and various cutaway views of the valves. A selection chart and installation and maintenance instructions are also included. ----------**Item 139**

AIR CLEANER CATALOG—An 8-page catalog (E-40) covering its packaged electronic air cleaners is released by Trion, Inc., McKees Rocks, Pa. The new book describes custom-built models in detail, including engineering data and size and capacity tables for fitting the proper model to the job. ----------**Item 140**

BULLETIN ON OIL PREHEATING—A bulletin (No. DT-56) containing information on oil preheaters, is issued by Alstrom Corp., New York, N. Y. The bulletin gives capacities, dimensions and also shows diagrams of positions for oil and boiler water tappings. Ratings are given for 6- and 2-pass units.----------**Item 141**

PUMP BULLETIN—Bulletin 4958-B describes a line of single and duplex condensation return pumping units made by The Deming Co., Salem, Ohio. Performance tables are included in the bulletin in addition to construction features and dimensions.----------**Item 142**

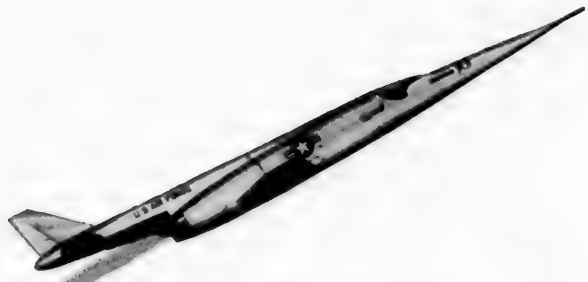
EXPANSION JOINT CATALOG—A 72-page catalog published by Zallea Brothers, Wilmington, Del., covers the design, manufacture and application of the company's line of packless corrugated expansion joints, including three new types. Designated as Catalog 56, it introduces self equalizing, duo equalizing, and high pressure expansion joints. ---------**Item 143**

GAS DETECTION DATA—Combustible gas detection equipment is the subject of a specification sheet available from Johnson-Williams, Inc., Palo Alto, Calif. The illustrated specification sheet gives detailed operational and construction data, application suggestions, and prices. ---------- **Item 144**

OIL HEATING BULLETIN—A bulletin on cast iron, oil-fired boilers is offered by National-U. S. Radiator Corp., Johnstown, Pa. The ratings and engineering data of the boilers are given in the bulletin in addition to their dimensions and tapping sizes. ----------**Item 145**

TECHNICAL TUBING FOLDER — Engineers and others involved with the design, maintenance, or repair of condensers and heat exchangers are offered a 6-page technical folder (TB-412) by Tubular Products div., The Babcock & Wilcox Co., Beaver Falls, Pa. A chart outlining the hydrostatic test pressures required for the various sizes of tubes under ASTM A-214 is also shown. ----------**Item 146**

REVISED PUMP BULLETIN—A revised bulletin (W-306-B3DP) on Monobloc centrifugal pumps for air conditioning systems is issued by Worthington Corp., Harrison, N. J. The bulletin illustrates ratings, dimensions, and the variety of sizes carried in local stocks maintained at district warehouses. ----------**Item 147**



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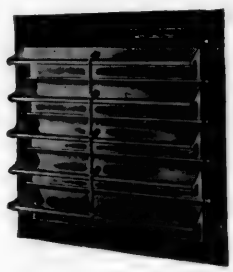

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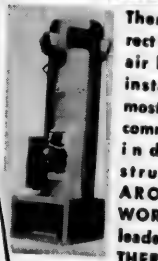

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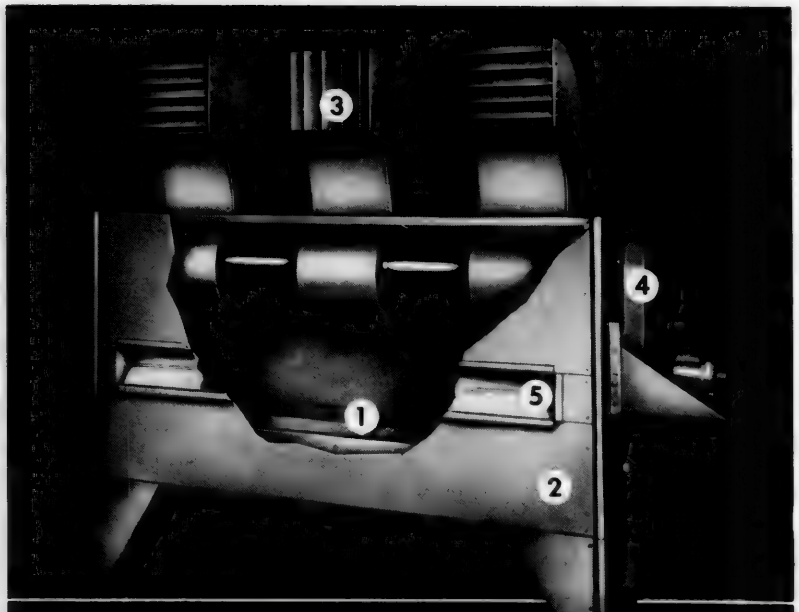

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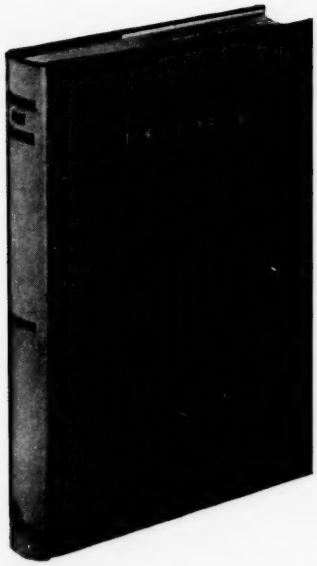

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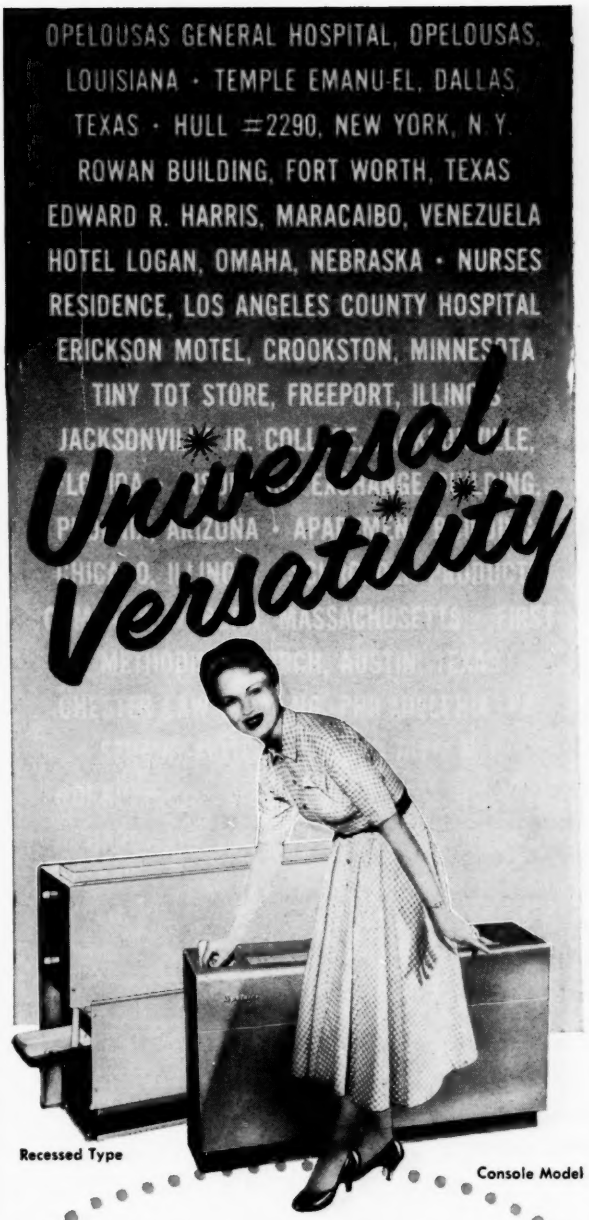
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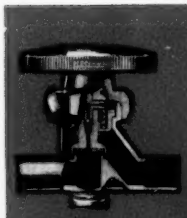
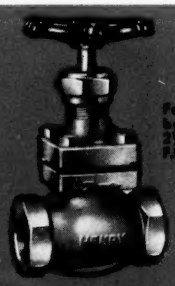
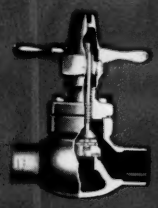


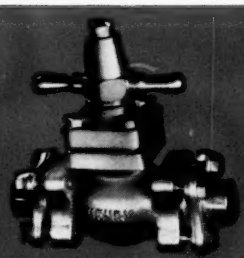
PACKLESS VALVE
With balanced-action. Sizes 1/4" through 5/8" F.L. 1/4" through 1 1/8" O.D.S.



AMMONIA VALVE
Forged steel or semi-steel bodies. Sizes 1/4" through 2 1/2" F.P.T., 1 1/2" through 6" F.P.T. slip-on welding or welding neck flanges.



WING CAP VALVE
Non-ferrous. Sizes 3/8" through 4 1/8" O.D.S.



WING CAP VALVE
Semi-steel screwed or flanged types. Sizes 1 1/4" through 6".

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no premium for...
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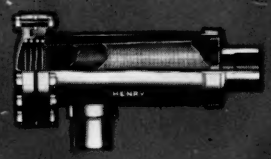
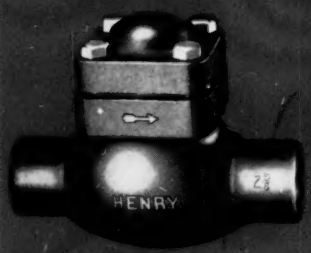
Henry products
or for the extra satisfaction that follows their use



STRAINER
Angle type with patented distortion-type flanges. Sizes 3/8" through 4 1/8" O.D.S., 2 1/2" through 6" butt weld.

Y-STRAINER
Brass plated. Welded steel construction. Forged brass connections. Sizes 1/8" through 4 1/8" O.D.S., 2 1/2" through 6" butt weld.

BALANCED-ACTION PACKLESS LIQUID LEVEL GAUGES
Valves are backseating—discharges may be inspected or replaced without loss of liquid. Conform with all safety code requirements. Also packed types, capped or with hand wheels.



SUCTION VALVES
Flange Type For Freon. Sizes 3/8" through 4 1/8" O.D.S.

STRAINER
Cartridge type 12 to 200 m. to. capacity. Sizes 3/8" to 2 1/8" O.D.S.

FILTER
Large diameter and capacity. All brass construction. Minimum pressure drop.

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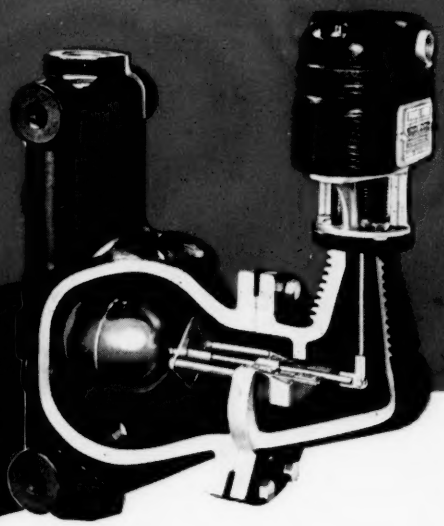
yes McDONNELL Controls for boilers up to 250 psi!



KNOW THIS 92 SERIES

In Four Models that meet all conditions

Here is the real answer to water level control for boilers up to 250 psi—the McDonnell 92 series providing pump control, low water fuel cut-off, and low water alarm.

This control has exactly what it takes for high pressure and temperature. Notice, for example, the generous float chamber with wide clearances between float and walls.

Keeping heat away from the switch mechanism is a foremost requirement in a control of this kind. In the 92 series an ingenious heat barrier, tapered neck, and fins, combine to effect an unprecedented heat dissipation—well proved by the fact that the 92 series complies with *current* underwriters' specification for 75°C wiring at switch terminals.

The 92 series combines a more effective use of magnetic switch actuation with McDonnell-built open contact switches—switches that do not call for the accurate alignment of the control that is necessary with other types.

There are too many features of the 92 series to cover here, but the whole story can be told in three words: *McDonnell quality throughout!* Note how the 92 series is built for you in four forms to fit right in to any boiler job requirement.

State your conditions. Let us help you select the right 92 series control for your job. Ask for complete engineering folder on 92 series installations, and wiring sheets.

McDONNELL & MILLER, *Inc.*
3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

What the 92 series does—The 92 series does three basic jobs, singly or in combination: **(1)** controls boiler feed pump *from* the boiler—exactly as it should be controlled for maximum efficiency **(2)** provides a low water fuel cut-off—cuts current to burner in the event of a low water emergency **(3)** closes circuit for operating low water alarm whenever low water occurs. Series 92 controls are also adaptable to a wide range of industrial liquid level control applications involving pressures up to 250 psi. Upper switch includes extra circuit to gain 3 wire operator for motor operated valves.

The Adaptable Water Column Form

There are two 92 series controls with self-contained, water-column bodies having tappings for water-glass and tri-cocks. Water-column form simplifies installation, provides correct equalization, cuts costs and assures a trim, workmanlike job. Tappings provide for mounting control on either side of the boiler with gauge glass mounted on either side of control. The two 92 series water-column types are:

1 **No. 292** Principle dimensions shown in drawing. Note cut-off level is 3½" above center of lower gauge glass tapping. This taller body with higher cut-off point assures water level being plainly visible when located high on a big boiler. Control may be installed with either top and bottom or side equalizing connections. Gauge glass tappings may be reduced to either ¾" or ½"; tri-cock tappings, ½"; equalizing tappings, 1¼" top and bottom, or 1" side.

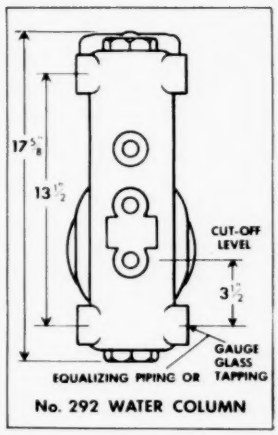
2 **No. 192** Dimensions opposite. Body is shorter, cut-off level lower than in 292, ideal for most fire-tube boilers. Both gauge glass and tri-cock tappings are ½"; equalizing tappings, 1¼".

Without Water Column

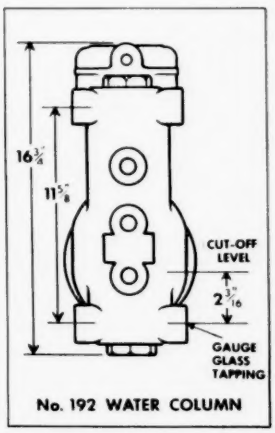
These two controls have the same basic operating mechanism as 192 and 292, but are designed for installation with independent water column.

3 **No. 92** Has 1¼" top and bottom equalizing tappings.

4 **No. 92A** Has two additional 1¼" side tappings for use where equalizing piping takes this form.



No. 292 WATER COLUMN



No. 192 WATER COLUMN

No. 92

No. 92A

Your Jobber Stocks Them

McDONNELL *Boiler Water Level Controls*